63D CONGRESS, 2d Session. | HOUSE OF REPRESENTATIVES. | DOCUMENT No. 584.

KANSAS RIVER UP TO KANSAS CITY, KANS.

LETTER

FROM

THE SECRETARY OF WAR,

TRANSMITTING,

VITH A LETTER FROM THE CHIEF OF ENGINEERS, REPORTS ON EXAMINATION AND SURVEY OF KANSAS RIVER, FROM THE MOUTH TO THE WESTERN LIMITS OF KANSAS CITY, KANS., WITH A VIEW TO REMOVING ALL OBSTRUCTIONS THEREFROM, DREDGING AND WIDENING THE MOUTH AND EXTENDING THE IMPROVEMENT SO AS TO FIT THE SAME FOR NAVIGATION, AND TO CONSIDER PROPOSITIONS FOR COOPERATION ON THE PART OF LOCAL AUTHORITIES AND INTERESTS.

ANUARY 13, 1914.—Referred to the Committee on Rivers and Harbors and ordered to be printed, with illustrations.

WAR DEPARTMENT,
Washington, January 13, 1914.

he SPEAKER OF THE HOUSE OF REPRESENTATIVES.

SIR: I have the honor to transmit herewith a letter from the cting Chief of Engineers United States Army, dated 12th instant, gether with copies of reports from Maj. Herbert Deakyne, Corps f Engineers, dated November 27, 1912, and October 10, 1913, with aps, on preliminary examination and survey, respectively, of Kans River, from the mouth to the western limits of Kansas City, ans., made by him in compliance with the provisions of the river d harbor act approved July 25, 1912.

Very respectfully,

LINDLEY M. GARRISON,
Secretary of War.

War Department,
Office of the Chief of Engineers,
Washington, January 12, 1914.

From: The Chief of Engineers, United States Army.
To: The Secretary of War.
Subject: Preliminary examination and survey of Kansas River, from the mouth to the western limits of Kansas City, Kans.

1. There are submitted herewith, for transmission to Congress, reports dated November 27, 1912, and October 10, 1913, with maps, by Maj. Herbert Deakyne, Corps of Engineers, on preliminary examination and survey, respectively, authorized by the following item contained in the river and harbor act approved July 25, 1912:

> The Kansas River, from the mouth to the western limits of Kansas City, Kans., with a view to removing all obstructions therefrom, dredging and widening the mouth and extending the improvement so as to fit the same for navigation, and to consider propositions for cooperation on the part of local authorities and interests.

2. The Kansas River, more commonly called the Kaw, is formed by the junction of the Republican and Smoky Rivers, flows easterly 176 miles, and empties into the Missouri River at Kansas City. Following the great flood of 1903, the State of Kansas created the Kaw Valley drainage district, under the control of the Kaw Valley Drainage Board, for the purpose of placing the river in condition to avoid the disastrous effects of another similar flood. In the river and harbo act approved July 25, 1912, Congress adopted a project for improvement of this river by the United States from the mouth up to Argentine, Kans., which provides for Federal supervision as to harbo line encroachments, bridge reconstruction, and removal of débri and obstructions from the bed of the river. The further work now proposed consists in a more active participation by the United State in the work of improvement so far as warranted in the interests o commerce and navigation. The district officer is of opinion that th present and prospective commerce of the river is sufficient to warran the expenditure by the United States of $10,000 in the construction of two dikes at the mouth of the river and the removal of solid obstructions from the river to 15 feet below low water, in accordance with the following estimate:

Removal of wreckage	$68, 00
Dikes at mouth	12, 00
Total	80, 00

It is proposed that railroads and other parties should pay $60,000 the Kaw Valley Drainage Board $10,000, and the United States $10,000. There is now on hand the sum of $4,000, appropriated fo execution of the present project, which should be made availab for the work now proposed. The division engineer concurs in believing that the river is worthy of improvement to the extent indicated

3. These reports have been referred, as required by law, to th Board of Engineers for Rivers and Harbors, and attention is invite to its accompanying report, dated December 2, 1913, concurring wit the views of the district officer and the division engineer.

4. After due consideration of the above-mentioned reports, I concur with the district officer, the division engineer, and the Board Engineers for Rivers and Harbors, and therefore report that the in

provement by the United States of Kansas River from the mouth to the western limits of Kansas City, Kans., is deemed advisable to the extent of constructing two dikes at the mouth and removing solid obstructions from the river to a depth of 15 feet below mean low water, at an estimated cost of $80,000, of which $10,000 should be borne by the General Government and the remainder by local interests. The sum of $4,000 on hand for the improvement of this river should be made available for the work now proposed, and the balance of the funds required, $6,000, should be provided in one appropriation.

EDW. BURR,
Colonel, Corps of Engineers,
Acting Chief of Engineers.

REPORT OF THE BOARD OF ENGINEERS FOR RIVERS AND HARBORS ON SURVEY.

[Third indorsement.]

BOARD OF ENGINEERS, FOR RIVERS AND HARBORS,
December 2, 1913.

To the CHIEF OF ENGINEERS, UNITED STATES ARMY:

1. The Kansas River is formed by the junction of the Republican nd Smoky Hill Rivers at Fort Riley, Kans. It flows in an easterly irection and empties into the Missouri River at Kansas City near he boundary between the States of Kansas and Missouri. The portion of the river covered by the present investigation extends from he mouth to the western limits of Kansas City, Kans., a distance of bout 6 miles.

2. A report submitted by authority of the act of March 3, 1909, pub- shed as House Document No. 94, Sixty-second Congress, first session, overs practically the same section of river, as well as the several sub- ects considered herein. Said report contains general descriptive matter concerning physical and commercial conditions. The district fficer notes the following changes that have occurred since the above eport was submitted: The obstructive dikes at the mouth of the iver have been removed; the work of the Kaw Valley Drainage Board in levee construction and in proceedings to have débris and bstructions removed has progressed; proceedings have been instituted by the district attorney for Kansas on behalf of the Federal Government; a number of bridges have been modified; a boat line etween Kansas City and St. Louis has been established; and the ndustrial development and the population of the vicinity have ncreased.

3. The commerce to be affected by the proposed improvement is estimated at 540,000 tons of sand, 6,700 tons of soap, etc., 15,000 tons f scrap iron, and 1,000 tons of boiler plate. These commodities are arried but short distances, the total ton-mileage being estimated at bout 600,000.

4. The river is seriously obstructed by wreckage, due largely to the isastrous flood of 1903, when some 17 bridges (all but one of those rossing the river in this vicinity) were swept from their foundations nd found lodgment in the bed of the stream. Oil tanks, freight ars, building material, railroad trackage, and other similar débris ere also left by this flood.

5. The purpose of the present investigation is clearly indicated i the law, as follows:

> The Kansas River, from the mouth to the western limits of Kansas City, Kans., wit a view to removing all obstructions therefrom, dredging and widening the mouth, an extending the improvement so as to fit the same for navigation and to consider propositions for cooperation on the part of local authorities and interests.

6. The Kaw Valley Drainage Board, in a letter[1] to the distric officer during his preliminary examination, stated that it woul cooperate with the Government in the execution of the work contemplated as soon as its cost had been ascertained. The survey an estimate which were necessary to determine the cost have been made

7. The plans of the drainage board provide for levees on each sid of the river, the excavation of the sand and mud between the levee down to mean low water, the removal of all solid obstructions dow to 15 feet below mean low water, and the control of bridges an other structures affecting the river. The district officer states th the clearing of the river of sediment and obstructions of all kinds an confining it between levees are favorable to navigation. On th other hand, the creation and maintenance of a navigable channel b contraction works would be detrimental to the free flow of the rive and therefore opposed to the purposes of the drainage board. Th district officer believes that the question of flood protection is mor vital than that of navigation, and that no steps should be take toward the improvement of navigation that would adversely affect th plans for flood protection.

8. The various works of improvement suggested involve the remova of wreckage and deposits, the excavation of channels, and the construction of two dikes at the mouth—one on the left bank of th Kansas River and one on the right bank of the Missouri—meeting i a point, as shown on the map, to improve the conditions at the confluence of the two rivers. Several estimates of improvement hav been prepared, as follows:

To construct the dikes at the mouth of the river	$12,00
To remove the solid obstructions or wreckage to 15 feet below mean low water	68,00
To dredge a channel 4 feet deep at mean low water, 150 feet wide from the mouth of the river to the Belt Line Bridge, and 100 feet wide above that point to the West Kansas Avenue Bridge	18,00
To dredge a channel 6 feet deep at mean low water and of the same widths as described above for the 4-foot channel	60,00
To remove all the deposits in the river between the levees to mean low water	630,00
To remove all the deposits in the river between the levees to 15 feet below mean low water	2,250,00

The estimate for removal of wreckage is only approximate and ma be exceeded.

9. The district officer is of opinion that the dredging of a chann either 4 or 6 feet deep would be of temporary benefit only, on accoun of deterioration. The general removal of deposits is not required i the interests of navigation, but the Kaw Valley Drainage Board plan to do this work down to mean low water as a part of its project fo flood protection. For the interests of navigation, therefore, th question is confined to the construction of the dikes at the mouth c the river and the removal of the solid obstructions, the latter bein

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[1] Not printed.

the more important. The most serious obstructions are bridge wreckage, and most of this can be identified, and its removal should be charged to those to whom it belongs. The district officer states that correspondence indicates that nearly all the responsible parties will participate in this work. Of the $68,000 estimated for the removal of wreckage, $60,000 should be furnished by the railroads and other concerns responsible. The Kaw Valley Drainage Board offers to contribute one-half of the remaining $8,000 required to emove wreckage the ownership of which is not established, and one-half of the $12,000 required to build the dikes.

10. While the removal of the wreckage is not expected to cause ny specific increase in channel depth, it will provide for a freer flow nd will tend to better navigation conditions. A depth of 4 feet is ll that is required for navigation on this stream, and this depth will robably be available as far up the river as the boat traffic extends. he only work of maintenance would be the repair of the dikes at he mouth, which is estimated to cost $1,000 per year. The district fficer believes the offer of the Kaw Valley Drainage Board to bear ne-half the cost of the dikes and of the removal of obstructions not hargeable to private concerns is reasonable and sufficient. He conludes with the opinion that present and prospective commerce of he river is sufficient to warrant the expenditure by the United tates of $10,000 in the construction of the dikes at the mouth of the ver and the removal of solid obstructions from the river to 15 feet elow mean low water, in accordance with the following estimate:

emoval of wreckage	$68,000
ikes at mouth	12,000
Total	80,000

The cost of the work to be divided as follows:

nited States	$10,000
aw Valley Drainage Board	10,000
ilroads and other parties	60,000

It appears that there is $4,000 on hand that should be made available for this work, leaving $6,000 additional to be provided by the nited States, which amount should be appropriated in one sum.

11. From the facts presented it appears that considerable progress as been made in the solution of the flood problem at Kansas City y the Kaw Valley Drainage Board; that the question of flood ontrol is the dominant one in this consideration and requires very xtensive work not needed in the interests of navigation; that only a mall part of the work being done and projected is of special benefit navigation; and that the locality offers to cooperate in this part n a 50 per cent basis.

12. The board believes the plan as outlined by the district officer fair and equitable and that it is advisable for the United States undertake the improvement on this basis. It therefore recommends the adoption of the project in accordance with the plans presented, at a total estimated cost of $80,000 for the removal of wreckage and the construction of dikes at the mouth of the river and $1,000 nually for maintenance, the share of the original cost to be borne the United States to be $10,000, that by the Kaw Valley Drainage Board $10,000, and that chargeable to other parties $60,000. There available $4,000, which, if authorized, could be applied to this work,

leaving the sum of $6,000 to be appropriated in one sum. There may be some delay in beginning removal of wreckage, on account of difficulty in securing cooperation of all the parties concerned, but this need not postpone the dike construction, which should proceed as soon as the necessary funds are available for this purpose.

13. In compliance with law, the board reports that, except as contemplated by the above recommendations, there are no questions o terminal facilities, water power, or other subjects so related to the project proposed that they may be coordinated therewith to lesser the cost and compensate the Government for expenditures made ir the interests of navigation.

For the board:

W. M. Black,
Colonel, Corps of Engineers,
Senior Member of the Board.

PRELIMINARY EXAMINATION OF KANSAS RIVER, KANS.

United States Engineer Office,
Kansas City, Mo., November 27, 1912.

From: The district engineer officer.
To: Chief of Engineers, United States Army
(Through the division engineer).
Subject: Preliminary examination of Kansas River, Kans.

1. In accordance with instructions contained in department lette of August 5, 1912, I submit the following report of preliminar examination of the Kansas River, Kans., required by this item o the river and harbor act approved July 25, 1912:

> The Kansas River from the mouth to the western limits of Kansas City, Kans with a view to removing all obstructions therefrom, dredging and widening the mout and extending the improvement so as to fit the same for navigation, and to conside propositions for cooperation on the part of local authorities and interests.

2. The examination was made on November 8, 1912. The Kansas River, more commonly called the Kaw, is formed by the junctio of the Republican and Smoky Hill Rivers at Fort Riley, Kans., an flows easterly about 176 miles, emptying into the Missouri River a Kansas City near the boundary line between the States of Kansa and Missouri. The river does not form part of the State boundar line, but near its mouth part of the river bottom lies in the State o Missouri, and the low water channel skirts the State line for a shor distance about 2 miles above the mouth. The portion of the rive covered by the act extends from the mouth to the West Kansa Avenue Bridge, a distance of 30,525 feet, or about 6 miles. This portion of the river lies within the limits of the city of Kansas City, Kans and close to Kansas City, Mo. These two cities have a total population of probably between 350,000 and 400,000. A map[1] is submitted herewith covering the stretch of river under consideratio and containing also a vicinity sketch showing the position of th part of the river with respect to surrounding territory. The preser low-water depth of the river is about 1½ feet, but the greatest obstac to navigation is the amount of wreckage in the river.

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[1] Not printed.

PREVIOUS REPORTS.

3. Previous reports on the river have been submitted as follows:

Report by Lieut. Col. Chas. R. Suter, Corps of Engineers, February 9, 1893, published on page 2293, Annual Report Chief of Engineers, 1893.

Report by Capt. H. M. Chittenden, Corps of Engineers, February 17, 1903, published as House Document No. 82, Fifty-eighth Congress, second session.

Three reports by a special board of engineer officers dated January 23, 1904, published as Senate Document No. 160, Fifty-eighth Congress, second session.

Reports by Maj. E. H. Schulz, Corps of Engineers, on preliminary examination, dated January 21, 1909, and on survey, dated December 9, 1910, published as House Document No. 94, Sixty-second Congress, first session.

This last report is accompanied by a map showing the results of the survey made at that time. The preliminary report of Maj. Schulz summarizes the previous reports mentioned.

4. Maj. Schulz recommended an appropriation of $29,000, of which $1,000 was for the removal of two dikes at the mouth of the river, $3,000 for the supervision of removal of débris, bridge reconstruction, and levee improvements, and $25,000 for additional work of removal of obstructions in direct interest of navigation and not otherwise provided for. The only appropriation that has ever been made for this stream is one of $4,000 in the act of July 25, 1912. No expenditure has been made under this appropriation, as action has been deferred pending the present examination.

PRESENT CONDITIONS.

5. As the survey report of Maj. Schulz was made less than two years ago, and as an extended report would be largely a repetition of matters covered in his report, it is merely necessary to note the changes that have occurred since his report was made and to state the present situation. In 1911 the Government removed the dikes near the mouth of the river as far as practicable. The work of the Kaw Valley Drainage Board in levee construction and bank protection is well advanced. The drainage board has taken steps to compel the removal of some of the débris and obstructions in the river and has filed suits against two railroad companies to compel such action. These suits have been decided by the State courts in favor of the drainage board, but have been carried to the United States Supreme Court on appeal. The United States district attorney for Kansas has been directed to commence similar suits on behalf of the Federal Government. The progress of the work of reconstructing the bridges is shown in the following table:

Bridges.	Present conditions.
1. Chicago Great Western	Nothing done toward modification.
2. Intercity Viaduct	Do.
3. James Street	Modified bridge nearly completed.
4. Kansas City Southern	Nothing done toward modification.
5. Central Avenue	Do.
6. Missouri Pacific	Modified bridge nearly completed.
7. Union Pacific	Do.
8. Stock Yards	Nothing done toward modification.
9. Chicago, Rock Island & Pacific	Do.
10. East Kansas Avenue	Bridge raised, but nothing done toward lengthening.
11. Belt line	Nothing done toward modification.
12. Fifth Street	New span put on left side to conform to the approved harbor lines.
13. Twelfth Street	Nothing done toward modification.
14. Argentine	Do.
15. West Kansas Avenue	Working on new pier for modified bridge.
16. Turner	Nothing to be done.

6. The principal changes in the industrial situation are the establishment of a boat line between Kansas City and St. Louis, the adoption by Congress of the project for the improvement of the Missouri River from Kansas City to its mouth, and the continued growth of Kansas City, Mo., and Kansas City, Kans. The rate at which these cities are growing is shown by the fact that in 1900 Kansas City, Mo., had a population of 163,752, which had increased by 1910 to 248,381, and that in the same time Kansas City, Kans., had increased from 51,418 to 82,331. The manufacturing establishments located on the banks of the Kaw River are reported to have an annual product valued at $200,000,000. The present commerce on the river consists principally of sand, estimated at 600,000 tons, with a value of $150,000, and grain and hay, estimated at 75,000 tons, with a value of $125,000—a total tonnage of 675,000 and total value of $275,000. The distance over which this commerce is handled on the Kaw River is small, being 1 to 3 miles. The prospective commerce amounts to 1,280,000 tons, consisting of 1,000,000 tons of sand, 150,000 tons of grain, hay, and coal, 80,000 tons of cement, and 50,000 tons of scrap iron. In addition there is a prospective commerce of flour, feed, soap, and other commodities, of which the amount in tons has not been estimated. The value of the prospective commerce is estimated somewhat in excess of $1,000,000 per year. Some of this commerce would be local and some of it would be general business, involving shipment to St. Louis and other distant points.

VIEWS OF INTERESTED PARTIES.

7. For the purpose of ascertaining the views of parties presumed to be interested in the improvement of the river, inquiry was made of the manufacturing establishments and other interests concerned. Numerous replies[1] have been received, and those from the following parties are forwarded as representing the most important views expressed:

The Fowler Packing Co.
The Cudahy Packing Co.
The Kansas City Stock Yards Co. of Missouri.
The Kaw Valley Drainage Board.
Stewart Peck Sand Co.
The Bonner Brand Portland Cement Co.
The United Zinc & Chemical Co.
Sonken-Galamba Iron & Metal Co.
G. L. Coates.
Peet Bros. Manufacturing Co.
The Southwestern Milling Co.
Kansas City-Missouri River Navigation Co.

8. It will be observed that the stockyards company and the packing companies are not interested in the development of the river for the purpose of navigation. Those products of the packing houses that require refrigeration can not be shipped by water at present. The packing houses must necessarily have definite arrangements with the railroad companies for handling their products, and they do not appear now to contemplate the use of river transportation even for those products that do not require refrigeration. Parties

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[1] Not printed.

nterested in the shipment of sand, scrap iron, grain, hay, flour
,nd feed, soap, and cement indicate that they would use the river
f made navigable and would consider it a great advantage in their
usiness. The Kansas City-Missouri River Navigation Co., which
perates the boats between Kansas City and St. Louis, is desirous
f having access to the Kaw River to obtain business offering from
stablishments on that stream. The statements of interested par-
ies contain nothing very definite as to the dimensions of the chan-
el desired, but as the Missouri River between Kansas City and its
iouth is being improved with a view to getting a permanent chan-
el of 6 feet depth, it would appear desirable that the Kaw River, if
nproved, should have an equal depth.

OBSTRUCTIONS.

9. The board of 1904 recommended that as a matter of flood pro-
ction the bed of the river should be dredged to a plane 15 feet
elow low water. If this is done, it will place the river in good con-
ition for navigation. The work will involve the removal of various
bstructions of which the kind and quantity are not fully known.
is expected that the river will be found to contain not only stone,
on, and timber from bridges, but also wreckage of buildings, cars,
l tanks, railroad track, and all manner of material that was swept
om the banks in 1903.

MOUTH OF RIVER.

10. The mouth of the river occupies an unfavorable position in
at the Kaw and the Missouri flow directly toward each other.
ie board of 1904 considered that on account of the existing con-
tions of occupancy of the ground along the banks it was imprac-
able to modify the mouth of the Kaw so as to secure the most
vorable confluence of the two streams. The matter should be
udied with a view to making such change as may be feasible with-
t undue expense.

TERMINAL AND TRANSFER FACILITIES.

11. There has been comparatively little development of terminal
d transfer facilities along the Kaw River. Many of the manu-
cturing establishments are sufficiently close to the banks of the
er to enable shipping facilities to be developed without diffi-
lty. The Stewart Peck Sand Co. has two unloading cranes for
ndling sand on the left bank of the river just below the West
insas Avenue Bridge. These facilities are considered efficient for
business of the owners. They are not open to the public. The
w Valley drainage district controls the banks of the river to a
tance of 40 feet landward from the harbor lines. The Kansas
y-Missouri River Navigation Co. has leased some land for a boat
rd and harbor on the banks of the Kaw near the mouth of the
er. The numerous railroads entering Kansas City can obtain
dy access to the banks of the Kaw. There appears to be no
stacle to prevent the development of both public and private
minals as rapidly as they are needed.

WATER POWER, FLOODS, AND OTHER RELATED SUBJECTS.

12. The river is subject to severe floods, of which the most seriou in recent years occurred in 1903. It is described at length on page 8 to 13 of the report of the board of 1904, Senate Document 160 Fifty-eighth Congress, second session. There is no plan for th development of any water power on the Kaw River, and any construction for that purpose would be objectionable on account o interfering with the free discharge of the stream. Any improvemen of the stream will contribute to the drainage of the watershed an will also assist in the reclamation of land along the banks.

COOPERATION.

13. The act requires special report upon the subject of cooperation Attention is invited to the statement of the Kaw Valley Drainag Board on this matter. The board has jurisdiction over all land i Kansas subject to overflow, extending from the mouth of the rive to about 4 miles above the limit of this examination. It has power of taxation, and in that way represents all landowners along thi part of the river. The board states that it will cooperate with th Government as soon as the cost of the work to be done has bee estimated. It is not expected that cooperation will be obtained fro any other parties except in so far as it may be possible to compel th removal of wreckage from the river by the parties owning or responsible for such wreckage.

CONCLUSION.

14. There appears to be a probability of the development increased navigation on the Kansas River, and it is practicall certain that cooperation can be secured for the necessary wor Before a definite report can be made as to cooperation, it will necessary to determine what work is to be done and how much will cost. In accordance with law, I have therefore to report th in my opinion a survey and estimate should be made to determi the advisability of improvement.

Herbert Deakyne,
Major, Corps of Engineers.

[First indorsement.]

Office of Division Engineer, Western Division,
St. Louis, Mo., November 30, 1912.

To the Chief of Engineers:

Concurring in the opinion of the district officer, as stated in par graph 14, and recommending that a survey and estimate be made determine the advisability of improvement.

C. McD. Townsend,
Colonel, Corps of Engineers.

[Third indorsement.]

BOARD OF ENGINEERS FOR RIVERS AND HARBORS,
December 10, 1912.

To the CHIEF OF ENGINEERS UNITED STATES ARMY:

As a survey appears to be necessary in order to comply with the provision of law requiring consideration of offers of cooperation, which must be based on character and cost of work proposed, the board concurs with the district officer and the division engineer in recommending a survey in order to determine the extent and advisability of the improvement.

For the board:

WM. T. ROSSELL,
Colonel, Corps of Engineers,
Senior Member of the Board.

SURVEY OF KANSAS RIVER, KANS.

UNITED STATES ENGINEER OFFICE,
Kansas City, Mo., October 10, 1913.

From: The district engineer officer.
To: The Chief of Engineers United States Army (through the division engineer).
Subject: Survey of Kansas River, Kans.

1. In compliance with instructions dated December 13, 1912, I submit the following report on survey of the Kansas River from the mouth to the western limits of Kansas City, Kans., called for by act of Congress approved July 25, 1912. A report on preliminary examination was submitted November 27, 1912.

2. The preliminary report contains a reference to previous reports and a general statement of the present conditions on the river. The river has never been cleared of the obstructions left in it by the great flood of 1903, and the present survey has in view the location of these obstructions and the preparation of a plan and estimate for their removal, together with the treatment of the river at its mouth and the fitting of the river for navigation.

3. The survey was made by Capt. Robert S. Thomas, Corps of Engineers, and attention is invited to the accompanying report by him, dated June 16, 1913. The results of the survey are shown on a map herewith, consisting of eight sheets. Capt. Thomas collected a large amount of information relative to the river and gave a great deal of study to the various phases of the problem presented. It is considered desirable that his report with the maps and tables accompanying it should be placed in permanent form for reference.

RESULTS OF SURVEY.

4. The survey shows that at mean low water the portion of the river covered by the survey, 6 miles in length, has a minimum depth of 3 feet in the thread of the channel and a depth of 1½ feet for a channel 100 feet wide. A depth of 4 feet at mean low water with a channel width of 100 feet can be carried from the mouth to the Fifth Street Bridge, a little over 3 miles. The river is alluvial in

character and its channel is subject to the same changes that are found in the Missouri and other rivers of this kind. The Kansas River, however, carries a large amount of building sand, and this furnishes much the largest part of the tonnage on the river.

5. In addition to the sand bars and mud deposits brought down by the river, it is obstructed by the débris of bridges, buildings, oil tanks, railroad cars and tracks, and other wreckage carried into the river in 1903. All available information relative to the amount and probable location of this wreckage was collected, and the river was then probed on lines extending across it averaging about 350 feet apart. By this means it is believed that almost all the wreckage was located, and its position is plotted on the map.

THE KAW VALLEY DRAINAGE BOARD.

6. Following the flood of 1903 the State of Kansas created the Kaw Valley drainage district, under the control of the Kaw Valley Drainage Board, for the purpose of placing the river in condition to avoid the disastrous effects of another similar flood. The plans of the drainage board provide for levees on each side of the river, the excavation of the sand and mud between the levees down to mean low water, the removal of all solid obstructions down to 15 feet below mean low water, and the control of bridges and other structures affecting the river. The drainage board has accomplished a considerable part of its program of levee construction and is actively following up the matter of improving conditions at the bridges, but has done comparatively little as yet toward the removal of the solid obstructions and the sand and mud between the levees.

7. The interests of the drainage board working toward flood relief and of the United States contemplating the improvement of navigation have much in common, though they are not identical. The removal of the sand, mud, and solid obstructions in the river, the regulation of bridges, and the confining of the river between levees are all favorable to navigation. On the other hand, the creation and maintenance of a navigable channel by confining the flow of the river by means of wing dams and training walls, such as are used on other streams like the Kansas River, would be detrimental to the purposes of the drainage board in providing for the free flow of the river in flood time. Taking into consideration the amount and nature of the present and prospective commerce and the magnitude of the interests affected by flood protection, I believe the latter interests to be the more important and am of the opinion that no steps should be taken to improve navigation by methods that would affect adversely the plans for flood protection.

TREATMENT OF THE MOUTH.

8. The act calls for a consideration of the matter of dredging and widening the mouth of the river. The Kansas empties into the Missouri River in such a way that its current and that of the Missouri are almost directly opposed. A modification of the flow, bringing the two currents together at a small angle, would benefit the river in the interests of both navigation and flood protection. On account

of the valuable land near the junction of the rivers it is not considered practicable to undertake any radical change in the position of the mouth of the Kansas River. Some widening of the mouth will be secured by the work of the drainage board in removing the deposits in the river between the levees.

PLANS AND ESTIMATES.

9. Various methods and degrees of treatment of the river have been studied and their cost has been estimated. To make such mprovement as is possible in the position of the mouth it is proposed to build two timber dikes, one on the left bank of the Kansas and one on the right bank of the Missouri, and to bring the outer ends of hese dikes together as shown on the map. This is expected to modify the direction of the currents slightly and to contribute toward he easier junction of the two streams. Estimates have been made of the cost of dredging channels 4 feet and 6 feet deep at mean low water and of removing the material between the levees to mean low water and to 15 feet below mean low water. Estimates have also been made of the cost of removing the solid obstructions in the river o 15 feet below mean low water.

10. These estimates may be briefly summarized as follows, the gures being given in round numbers and including allowances for ngineering and contingencies:

o construct the dikes at the mouth of the river	$12,000
o remove the solid obstructions to 15 feet below mean low water	68,000
o dredge a channel 4 feet deep at mean low water, 150 feet wide from the mouth of the river to the Belt Line Bridge, and 100 feet wide above that point to the West Kansas Avenue Bridge	18,000
o dredge a channel 6 feet deep at mean low water and of the same widths as described above for the 4-foot channel	60,000
o remove all the deposits in the river between the levees to mean low water	630,000
o remove all the deposits in the river between the levees to 15 feet below mean low water	2,250,000

11. It is my opinion that the dredging of a channel 4 or 6 feet deep would be of only temporary benefit, because the sediment cared by the river would fill the dredged cuts as soon as a high stage of river occurred. The removal of the deposits to mean low water is a measure for flood relief, but would be of little or no value for puroses of navigation. The removal of these deposits to 15 feet below mean low water would put the river in condition to carry off floods and would also make it easily navigable, but it could not be expected o remain permanently clear of deposits to such a depth. Moreover, his last operation is considered unnecessarily expensive from the tandpoint of either navigation or flood protection.

12. The Kaw Valley Drainage Board plans to remove the deposits down to mean low water. There appears to be no reason for the United States to incur any expenditure for this purpose. For the nterests of navigation the question is reduced to the construction of the dikes at the mouth and the removal of the solid obstructions. With the changes in the river the channel may change to various ositions between the levees. It is therefore important to navigation that all the solid obstructions between the levees should be removed.

COMMERCE.

13. Further investigation of the present and prospective commerce has been made. The result indicates that the present commerce is practically confined to the transportation of sand, and that the amount is somewhat less than the figure reported in the preliminary examination. The prospective commerce is also less than was given in the preliminary examination report. The figures given by interested parties and used in that report have been subjected to furthe scrutiny and reduced to agree with the actual conditions. There is a reasonable prospect of a commerce of about 562,700 tons of 2,00 pounds, consisting of—

	Tons.
Sand	540,00
Soap, caustic soda and glycerine	6,70
Scrap iron	15,00
Boiler plate	1,00

These articles would be carried over distances of from 1 to 5 miles The total ton-mileage is estimated at about 600,000 ton-miles.

IMPROVEMENT REQUIRED.

14. The most important step now to be undertaken is the remova of the solid obstructions in the river. It is supposed that nearly al of these obstructions consist of wreckage that can be identified a belonging to certain railroads and other concerns, and it is believe that the owners should bear the cost of its removal. Letters hav been sent to 14 parties calling their attention to the wreckage supposed to belong to them and asking whether they prefer to remov this wreckage independently or to bear their equitable share in a general clearing of the river to be done by the United States. Replies have been received which indicate that in 11 cases the responsibl parties will remove their wreckage or join with the Government in th work; one is investigating and has not made final answer; and tw have expressed their unwillingness to do anything. These last tw cases are of small importance and expense. In general, I conside that the replies indicate that the clearing of the river can be accomplished.

15. It is estimated that of the $68,000 required to remove th wreckage, $60,000 should be borne by the railroads and other concerns responsible and that $8,000 required to remove wreckage o which the ownership can not be established, should be borne equall by the United States and the Kaw Valley Drainage Board. The cos of the dikes at the mouth, $12,000, should also be divided in the sam way, as both pieces of work are beneficial to navigation and floo protection. The Kaw Valley Drainage Board, under date of September 11, 1913, indicated its willingness to pay one-half the $20,00 required for these two pieces of work.

16. The removal of this wreckage is not expected to cause an specific increase in channel depth, but it will rid the river of dangero obstructions, and will enable it in time of flood to move the sedime in the bottom more freely, and will tend to give greater depths f navigation. A depth of 4 feet is all that is required to accommoda

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[1] Not printed.

resent and prospective commerce, and it is believed that if the
reckage is removed and the drainage board carries out its plans for
emoving the earth between the levees to mean low water, this depth
hould be found for a sufficient distance up the river to provide for
onsiderable commerce.

17. There is available $4,000 appropriated by the river and harbor
ct of July 25, 1912, for the improvement of the Kansas River. It
ould require an authorization of the use of this amount for the work
erein described and an additional appropriation of $6,000 to make
p the share of the United States in the improvement. For the main-
enance of the improvement the only work required is the repair of
he dikes at the mouth. This is estimated at $1,000 per year. If a
eposit occurs in the area between these dikes it may be advisable later
n to revet the shore line so created, especially on the Missouri River
de.

18. The matters of terminal and transfer facilities, water power,
oods, and other related subjects are covered in the preliminary re-
ort. There appears to be no need of requiring the creation of public
rminal and transfer facilities as a condition of the participation of
e Government in the improvement.

COOPERATION.

19. The offer of the Kaw Valley Drainage Board to bear one-half
e cost of the dikes and of the removal of obstructions not chargeable
private concerns, is considered reasonable and sufficient. I think
e most satisfactory way to carry on the work will be to have it done
y the United States either by contract or by hired labor. The rail-
ads and other parties held responsible for portions of the wreckage,
well as the Kaw Valley Drainage Board, should turn over to the
cretary of War prior to the commencement of the work the
nounts estimated as their shares of the cost. I desire to point out
rticularly that on account of the unusual nature of the work, and
the possibility of finding additional wreckage as the work proceeds,
close estimate of its cost can not be made. The figures adopted
e based partly on the experience already had by two concerns that
ve removed some of the wreckage, and partly on a consideration
the length of time it would take to go over the river with a suitable
ant and operating force. The parties contributing to the cost of the
ork should understand that the cost may exceed the estimates and
ould agree to bear their share of such increased cost if necessary.
make the matter definite, their liability should be limited to an
crease of 50 per cent over the estimates.

20. The recommendations herein made are not intended to conflict
th any legal steps that may be taken to force the railroads and other
rties responsible for wreckage to remove the same. For some years
st legal process of this kind has been carried on by the Kaw Valley
rainage Board, but thus far without result in the way of actual
moval of obstructions. The Federal Government instituted pro-
edings against two railroads, the Missouri Pacific and the Union
cific, and the decision established the jurisdiction of the Govern-
ent over the stream and the power of the Government to require
e removal of obstructions down to scour line. These two railroad
mpanies and the stock yards company have removed a large

amount of wreckage chargeable to them, but are now held responsibl for several items not covered by their former operations. Durin the past few weeks the United States district attorney has taken u the matter of further action in regard to obstructions in the rive If proceedings by him or by the drainage board should produc results in the way of removal of obstructions by the responsibl parties, or if any of these parties should proceed voluntarily to remov their wreckage, such results would not conflict with the aim of thi report. If all such wreckage chargeable to the various parties shoul be removed by them, there would remain only the removal of thos obstructions for which responsibility can not be placed, and this wor could be done jointly by the United States and the drainage board.

CONCLUSION.

21. I am of the opinion that the present and prospective com merce of the river is sufficient to warrant the expenditure by th United States of $10,000 in the construction of the dikes at th mouth and the removal of the solid obstructions from the river to 1 feet below mean low water. This work is estimated to cost as follow

Removal of wreckage	$68, 0
Dikes at mouth	12, 0
Total	80, 0

Estimated cost of maintenance, $1,000 per year.

The cost of the work should be divided as follows:

United States	$10, 0
Kaw Valley Draniage Board	10, 0
Railroads and other parties	60, 0

There is $4,000 on hand that could be applied to this work, as men tioned above. The $6,000 required to make up the Government share of the expense should be appropriated in one sum. The wor should be carried on at such a rate as to complete it in from one t two years.

HERBERT DEAKYNE,
Major, Corps of Engineers.

[First indorsement.]

OFFICE DIVISION ENGINEER, WESTERN DIVISION,
St. Louis, Mo., October 28, 1913.

To the CHIEF OF ENGINEERS UNITED STATES ARMY:

Concurring in the recommendations of the district engineer offic as expressed in paragraph 21 "That the present and prospecti commerce of the river is sufficient to warrant the expenditure by th United States of $10,000 in the construction of the dikes at the mout and the removal of the solid obstructions from the river to 15 fe below mean low water."

C. McD. TOWNSEND,
Colonel, Corps of Engineers.

[For Report of the Board of Engineers for Rivers and Harbors o survey see page 3.]

APPENDIX A.

REPORT OF CAPT. R. S. THOMAS, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Kansas City, Mo., June 16, 1913.

From: Capt. R. S. Thomas, Corps of Engineers.
To: The District Engineer Officer, Kansas City, Mo.
Subject: Report of survey of Kansas River.

1. The preliminary examination of the Kansas River from the mouth to the western imits of Kansas City, Kans., was directed by act of Congress of July 25, 1912. A survey was authorized December 13, 1912, and $3,000 was allotted for this purpose.

2. Work was commenced in January, 1913, but the severe weather and ice conditions prevented continuous work. A survey from the mouth to West Kansas Avenue Bridge was made in 1904 by this office for the purpose of establishing the harbor lines. The triangulation points, levels, and the general topography without the harbor lines were taken from this former survey. The new survey consisted of—

(*a*) Transit and stadia line connecting Turner with West Kansas Avenue Bridge, nd a topographic survey of the waterway included within the levees.

(*b*) Levels determining the profile of the water surface, the zeros for the gauges, and stablishing bench marks at numerous places.

(*c*) Soundings.

(*d*) A series of discharge measurements.

(*e*) Establishment of gauges for the study of the effect of back water from the Missouri.

(*f*) The location of débris, old bridge steel, piers, and other wreckage lying in the bed of the river.

(*g*) Wash borings, to determine whether blue clay stratum exists above the proposed scour line.

THE MAP.

3. The map (8 sheets, Q. 375/1–8) shows the topography, elevation of water surface oundings, and the location of débris and wreckage. The topography between the evees is from the transit and stadia survey of January, 1913, while the remaining opography is taken from the map of survey of 1904.

4. The elevation of the water surface was determined by a line of levels, the observations being corrected for difference in stage so as to reduce the water surface to the tage existing January 18, 1913, 308.4 feet at the Hannibal Bridge and 311.1 at the Twelfth Street Bridge. (Q. 376/1.)

5. The soundings show the depth below the established mean low-water plane, corections for stage having been applied to the actual observations. Soundings were made at 25-foot intervals in each section and read to the nearest one-half foot. The ounding ranges were approximately 1,000 feet apart above West Kansas Avenue Bridge and approximately 500 feet apart from below the West Kansas Avenue Bridge Argentine) to the mouth.

PROFILES.

6. The elevations of the water surfaces for various stages of the river are shown on Q. 376/1. This sheet shows in profile the following:

(*a*) Bed rock and outcrop of blue clay.

(*b*) Assumed scour line, 15 feet below standard low water.

(*c*) Profile of river bottom, January, 1913.

(*d*) Bottom of a 6-foot channel, 6 feet below mean low water.

(*e*) Bottom of a 4-foot channel.

(*f*) Water surface of January 18, 1913.

(*g*) Mean low water surface, or surface of water to correspond to the mean stage of he lowest month of the navigation season.

(*h*) Standard low-water plane. The standard plane used in previous reports.

(*i*) Profile of water surface, resulting from back water from the Missouri River at bank-full stage on April 16, 1913.

(*k*) Water surface of 1904 flood.

(*l*) Water surface of 1908 flood.

(*m*) Levee grade line—30 feet above standard low water.

(*n*) Water surface of 1903 flood.

7. The borings shown are from the bridge plans submitted by the owners of th bridges, with the exception of those borings made by this office to determine th location of the blue clay stratum in vicinity of the Missouri Pacific, Central Avenue and James Street Bridges. (Q. 376/4.)

8. The scour line, standard low water, and elevation of top of levee are based o the hydraulic gradient at flood stage as assumed by the Engineer Board of 1904. (S Doc. No. 160, 58th Cong., 2d sess.) This board stated—

"The uniform slope of the river over the entire stretch considered is 1.5 feet pe mile, which, with a section like that above described, would develop a mean velocit at extreme flood stage of between 10 and 13 feet per second. Under such velocity river bed composed of soft alluvium, like that of the Missouri and Kaw Rivers, an freed of all solid obstructions as proposed, would experience a heavy scour. Assum ing this to extend to an average of 15 feet below the low-water plane of the rive which would be 7 to 8 feet below the bed, the resulting sections would carry a floo like that of 1903."

Standard low water at the Hannibal Bridge, computed under the method used a that time, was 308.67. Hence, the standard low-water stage at the mouth of th Kansas River was assumed at 309 (p. 20, H. Doc. No. 94, 62d Cong., 1st sess.), and th standard low-water plane was established by starting at the elevation of 309 at th mouth and rising on a uniform slope of 1.5 feet per mile. The scour line was assume parallel to and 15 feet below the standard low-water plane. The top line of the leve is to be 30 feet above this standard low-water plane and 45 feet above the scour lin

9. The profile of river bottom is from the channel soundings made in January, 191

10. The profile of water surface of January 18, 1913, is from a line of levels ru January 11 to February 14, 1913, the observations being corrected for change in stag to reduce the water surface to the stage of January 18, 1913. Ice conditions affecte this problem, so the elevations, corrected for change of stage, were plotted and th curve that seemed best to satisfy all conditions was drawn. The lowest stage of 191 occurred on January 11 with a stage of 305.1 at the Hannibal Bridge on the Missou River. The lowest previous low water is 303.7 at Hannibal Bridge in 1884.

11. The mean low-water plane shows the probable water surface profile at mean lo stage. The standard low-water plane as adopted was found not to conform to th actual low-water surface. Also a new standard low-water elevation for Kansas Cit at the Hannibal Bridge had been determined from the mean elevation during tha month of the navigation season in which occurred the lowest water. The table belo shows how this is determined:

TABLE I.—*Table of low-water elevations Missouri River, Kansas City, at the Hannib Bridge.*

[Showing mean elevation for each month, in which occurs the lowest water during navigation seaso Mar. 1–Dec. 1, 1875–1911.]

Year.	Month in which occurred the lowest water during navigation season.	Mean elevation.	Year.	Month in which occurred the lowest water during navigation season.	Mean elevation.
1875	November	309.18	1896	November	310.
1876	do	310.04	1897	October	307.
1877	October	309.77	1898	November	309.
1878	do	309.98	1899	October	308.
1879	March	310.66	1900	November	311.
1880	November	308.17	1901	do	310.
1881	do	311.72	1902	do	311.
1882	do	308.27	1903	do	311.
1883	do	309.66	1904	do	309.
1884	March	312.39	1905	October	310.
1885	October	309.46	1906	March	311.
1886	November	307.79	1907	November	310.
1887	do	310.53	1908	October	311.
1888	do	309.93	1909	November	313.
1889	October	307.96	1910	do	307.
1890	March	310.42	1911	do	308.
1891	November	308.99			
1892	do	309.09	Mean		309.
1893	do	309.26	Old standard, low water.		308.
1894	do	309.61			
1895	do	308.95			

A study of the effect of the stage of the Missouri River upon the stage at several points in this stretch of the Kansas River warrants, in absence of extensive records of low water in the Kansas River, our assuming the mean low-water stage of the Kansas River as that stage corresponding to the standard low-water stage of the Missouri River at the Hannibal Bridge, viz, stage 309.86. By a careful comparison of the gauge readings at various points in the Kansas River with the corresponding gauge readings at the Hannibal Bridge, we are able to plot the probable water surface of the Kansas River for standard low-water stage in the Missouri River. This profile we call the mean low-water plane to distinguish from the standard low-water plane used in former reports. This mean low-water plane represents the mean stage "during the month of lowest water in the navigation season." The plane (curve d) 6 feet below the mean low-water plane, therefore, indicates the bottom of a 6-foot channel as defined in the river and harbor act of July 25, 1912, section 7. The following table shows the elevation of the mean low-water plane at the several determining points in the Kansas River:

TABLE II.—*Mean low-water plane, Kansas River.*

Location.	Elevation.	Approximate slope, feet per mile.	Slope.	
			From—	To—
Hannibal Bridge	309.9			
James Street Bridge	310.6	0.41	Hannibal Bridge	James Street Bridge.
Twelfth Street Bridge	311.4	.21	James Street Bridge	Twelfth Street Bridge.
West Kansas Avenue Bridge.	312.4	.63	Twelfth Street Bridge	West Kansas Avenue Bridge.
Turner Bridge	322.4	2.63	West Kansas Avenue Bridge.	Turner Bridge.

12. Curve (i) shows the water surface on April 16, 1913, when the Missouri River was at bank-full stage, 22 feet, elevation 325.5; while the Kansas was at moderately low-water stage at Topeka. This curve gives an excellent idea what effect back water from the Missouri can have on this stretch of the Kansas River. It practically produces one long pool extending to beyond Turner, Kans., 9½ miles above the month.

13. Curves (k), (l), and (n) showing profiles of the floods of 1094, 1908, and 1903 are derived from various data on file in this office.

EFFECT OF BACKWATER FROM THE MISSOURI.

14. In order to determine the regulated flow in the proposed channel, the velocity and the resultant scouring out or filling up of a dredged channel, it became necessary to study the effect of the backwater from the Missouri upon the stage, slope, velocity, and discharge in this stretch of the Kansas River. Gauges were established at several points and the height of water surface recorded each morning and evening; the gauge heights are recorded in Table III, Appendix B. The results from this table are shown graphically on figure 5, Appendix C. The hydrographs of the Missouri River at the Hannibal Bridge, Kansas City, and of the Kansas River at Topeka, about 70 miles from mouth; Turner, 9.5 miles from the mouth; West Kansas Avenue Bridge (mile 5.9); Twelfth Street Bridge (mile 4.3); Central Avenue Bridge (mile 1.2); and James Street Bridge (mile 0.5), are shown on figure 5.

15. Temporary gauges were first established at the Chicago Great Western Bridge near the mouth, at Central Avenue Bridge, Twelfth Street Bridge, and Turner Bridge. It was observed that near the stage of 311 (Hannibal Bridge) and above, the gauge readings at the Central Avenue and Great Western gauges were sufficiently close to warrant the establishemnt of one permanent gauge at the James Street Bridge to replace the gauge at the Great Western Bridge. It is understood that the Great Western and Central Avenue Bridges are soon to be changed, while the James Street Bridge has recently been completed according to the approved plans—so, when further observations showed that the James Street Bridge gauge could also replace the Central Avenue Bridge gauge, the latter place was abandoned and a new gauge was established at West Kansas Avenue Bridge.

16. A study of the hydrographs, Appendix C, points to the following conclusions:

(*a*) Even at the low stage any rise or fall in Missouri River produces a corresponding rise or fall in the mouth of the Kansas River.

(*b*) Though appreciable at lower stages, the effect of a change in the water-surface elevation of the Missouri River becomes markedly so at points on the Kansas River at the respective elevations, shown in the following table:

TABLE IV.

Location of gauge.	Distance above mouth.	Elevation of water surface at which the effect of Hannibal Bridge stage becomes marked.	Elevation at which section becomes flooded and slope very flat.[1]	The probable elevation of extreme low water.
	Miles.			
Great Western Bridge	0.3	308	311.5	307.
James Street Bridge	0.5	308	311.5	307.
Central Avenue Bridge	1.2	308	312	307.
Twelfth Street Bridge	4.3	310.5	313	310
West Kansas Avenue Bridge	5.9	312	315.5	311
Turner, Kans	9.5	325.5	326.0	321

[1] From figures 1 and 3.

(*c*) Expressing Table IV in other words, we conclude that for an ordinary low-wate discharge in the Kansas River of from 1,000 to 3,000 feet per second, we will hav backwater in the Kansas River up to the following places for the respective stages a the Hannibal Bridge:

Backwater in the mouth, for stages of the Hannibal Bridge above	311.
Backwater and small slope up to Central Avenue Bridge for elevation at Hannibal Bridge of	311.
Backwater and small slope up to Twelfth Street Bridge for elevation at Hannibal Bridge of	312.
Backwater and small slope up to West Kansas Avenue Bridge for elevation at Hannibal Bridge of	313.
Backwater and small slope up to Turner for elevation at Hannibal Bridge of	323.

17. In order to make a more complete study of the relation of stage at various point in the Kansas River to the stage at Hannibal Bridge, points showing the 12-hou gauge readings were plotted with the Hannibal gauge reading as ordinates and th Kansas River readings as abscissas. These curves are shown on figure 1, Appendix C They were plotted from observations taken from about January 15 to include May 3 During this time the Kansas River was at low stages, from 321.3 to 327.8 at Turne gauge, with discharge varying from 1,000 to not over 4,000 feet per second, while th Missouri River varied from the very low stage of 305.2 to the bank-full stage of 325. The reliability of these curves is limited to conditions similar to those existing at th time the observations were made. From observation of the gauge relations it is be lieved that for any constant discharge of the Kansas River the curve plotted to sho the effect of backwater from the Missouri upon the stage in the Kansas River woul be in shape similar to a parabola; but the data available are not yet sufficient and th effect of other variables in the problem has been too indeterminate to arrive at an satisfactory equation expressing numerically the relation between the stages in th two rivers. (See Fig. 2, Appendix C.) However, the question of the relative stag of the two rivers seems to be an important factor. For instance, with the Kans River low and Missouri River in flood the stage at a given point in the Kansas Riv for a certain stage of the Missouri River would probably be lower than that shown b the curve. Also the slopes would be flatter than those shown in figure 3. On th other hand, with the Kansas River in flood and the Missouri River at low stage th conditions would be the reverse.

SLOPES.

18. The slopes in the several sections of the river vary with the stage. As the que tion of slope and velocity has an important bearing upon the maintenance of a reg lated channel, a study was made of the gauge readings to determine the slopes of th several sections at different stages. (See Fig. 3, Appendix C.)

19. For convenience we will consider the following divisions:

(A) Hannibal Bridge to the mouth, as determined by the gauges at Hannibal Brid and at Great Western gauge or James Street gauge.

(B) Mouth to Twelfth Street Bridge, as determined by James Street gauge and Twelfth Street gauge. At the lower stages this section is not of uniform slope, so for he stages below 314 the slopes for the stretches (a) from James Street Bridge to Central Avenue Bridge and (b) from Central Avenue Bridge to Twelfth Street Bridge are hown.

(C) Twelfth Street to West Kansas Avenue. The West Kansas Avenue gauge was stablished late and the data for constructing this curve are not so complete as for the ther curves.

(D) West Kansas Avenue Bridge to Turner, Kan. From curve (c) we can estinate the stage at West Kansas Avenue gauge from the gauge reading at Twelfth Street Bridge for the time prior to establishing the West Kansas Avenue gauge. These estinated values were used for constructing the part of curve (d) for the lower stages.

20. *Mouth to Hannibal Bridge* (Curve A, Fig. 3).—As the Missouri River rises above he bar at the mouth of the Kansas River this slope becomes about 0.7 feet per 1,000 eet or 0.00007 for stage 308. As the Missouri stage increases the effect seems to be due to cause the slope to increase almost uniformly with an increase in stage, up to bout 0.00021 for stage 325. For the time during these observations[1] this slope varied rom about 0.00010 to 0.00025, with a mean slope of 0.00012 or 0.63 feet per mile.

21. *In mouth of the Kansas River* (Curves a and b and B).—We note that at the lower tages the slope from the mouth to Central Avenue varies from the slope of about 0.00010 t stage 308.5 to zero at about stage 311.5, and the slope from Central Avenue to Twelfth Street from 0.00010 at 307 to the very flat slope of 0.00002 at 311.5.

(Curve B.) Considering the whole stretch from James Street to Twelfth Street we ee that the slope decreases gradually from 0.00008 to 0.00003, with an increase in stage from 308 to 311, and that above stage 311 the slope is very small, and the change in slope ue to an increase in stage is very slight. In other words, this section of the river is ractically a lake due to backwater from the Missouri for stages above 312, on the Hannibal Bridge gauge.

The mean slope for the time covered by these observations[1] is 0.00003, or about 0.16 feet per mile.

22. *Twelfth Street Bridge to West Kansas Avenue Bridge* (Curve C).—The data for his particular stretch are meager, but are sufficient to show a slope of 0.00030 at extreme low water and that this stretch becomes flat at about stage 313.5, Hannibal Bridge.

The mean slope is 0.00009, or 0.47 feet per mile.[1]

23. *West Kansas Avenue to Turner.*—We see that for stages below 311, Hannibal Bridge, the slope in this section is about 0.00048 and is practically independent of he stage of the Missouri River. (Observe Table III, Appendix B.) From stage 311 to stage 323 the slope flattens from 0.00046 to 0.00006, and above stage 323 or 324 we have practically one long pool extending 9.5 miles up the Kansas River from the mouth.

The mean slope[1] of this stretch is 0.00039, or 2.08 feet per mile. This gives a mean ope[1] from the Mouth to Turner of 0.00018, or 0.96 feet per mile.

24. As stated above, it must be remembered that the above apply only to conditions milar to those existing during the time of these observations. In this period the Kansas River has remained low, the discharge varying from 1,000 to about 4,000 ubic feet per second, while the Missouri has risen from very low water, 305.2, to ank-full stage, 325.5. With a greater flow in the Kansas River the slopes as deterined may be steeper, and the pools produced by backwater from the Missouri may reach the different points at a higher stage than those given above. We see, however, hat there are times when this entire stretch of river is one pool, and during that time no assistance in cleaning out or deepening the channel can be expected from the effects f scour.

25. Table XVII, page 18, shows the mean monthly slopes for the mean monthly ages at the different gauges. These tables include observations after May 3 and to clude June 28, 1913. The effect produced by high water in the Missouri upon the opes in the Kansas River is evidenced by the slopes during April and June, while he high water from the Kansas River in May does not seem to have produced any arked difference in the mean slopes from those of the winter months.

DISCHARGE AND VELOCITY.

26. The United States Geological Survey gives the following for the Kansas River Lecompton, Kans., about 51 miles above the mouth, with a discharge estimated be 95 per cent of that at the mouth.

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[1] For period January 12 to May 3.

TABLE V.

	Gauge at Lecompton.	Discharge.
	Feet.	*Second-feet.*
Water-Supply Paper No. 66 (1902):		
May 24, 1901	2.30	74
Aug. 15, 1901	3.20	3,24
Oct. 13, 1901	2.70	1,43
Water-Supply Paper No. 84 (1903):		
Apr. 28, 1902	3.00	1,34
July 12, 1902	16.35	72,17
Aug. 27, 1902	7.70	17,72
Water-Supply Paper No. 99 (1904):		
May 19, 1903	9.30	24,29
May 29, 1903	21.10	95,01
May 31, 1903	29.50	[1] 280,00
June 27, 1903	9.20	28,03
Aug. 29, 1903	11.15	47,64

[1] Estimated.

Discharge measurements for 1905 at Lecompton are the following (Water-Suppl Paper No. 172, 1906):

TABLE VI.

	Width.	Area.	Velocity (feet per second).	Gauge.	Dis-charge.
	Feet.	*Sq. ft.*		*Feet.*	*Sec.-ft.*
Apr. 14	744	2,104	2.55	3.20	5,3
May 28	771	5,546	3.39	7.00	18,8
July 8	801	9,866	5.00	12.35	49,3
Oct. 9	644	1,497	2.22	3.30	3,3

	Second-fee
Mean for year	11,0
Monthly minimum, October	4,8
Monthly maximum, July	21,8

Measurements of Kansas River at Kansas City, Kans., April 6, 1909, by the chi engineer of the stockyards company:

(*a*) Location 300 feet above Rock Island Bridge; stage, 6.56; width, 500 feet; max mum depth, 15 feet; average depth, 7 feet; area, 3,500 square feet; velocity, 1 fo per second; discharge, 3,500 cubic feet per second.

(*b*) Location, 300 feet below Rock Island Bridge; stage, 6.34; width, 486 feet; max mum depth, 13 feet; average depth, 7.4 feet; area, 3,506 square feet.

Discharge readings of 1883 are as follows, taken from the report of the Chief of Eng neers of 1887, page 3086. The observations were made at a point 8,400 feet above th mouth, about midway between the Union Pacific and stockyards bridges:

TABLE VII.

[Datum 318.27 above St. Louis.]

[H. Doc. No. 94, 62d Cong., 1st sess.]

	Dates.	Local gage.	Kansas City gage.	Dis-charge.	Area.	Veloc-ity.	Width.	Mean depth
	1883.							
1	July 25	318.27	316.77	4,418	5,946	0.74	585	10.
5	Aug. 14	315.18	313.84	5,164	2,885	1.79	532	5.
7	Aug. 21	317.20	315.38	12,345	3,919	3.15	573	6.
16	Sept. 29	310.85	308.98	2,021	1,091	1.85	333	3.
19	Oct. 13	311.30	308.90	2,496	1,314	1.90	333	3.

27. Measurements made during this survey give the following results:

TABLE VIII.

DISCHARGE OBSERVATIONS—1913.

Date.	Station.	Discharge.	Stage, Hannibal Bridge.	Area.	Slope (feet per 1,000).	Mean velocity observed.	N and C from Kutter's formula.		C from expotential formula.
an. 24	D1	1,118	308.8	647.3	0.45	1.73	0.025	62	76.9
an. 25	D2	1,540.5	309.1	1,077	.081	1.43	.019	90.4	109.2
pr. 17	D2	3,157.3	324.4	6,770	.01	.467	....	....	....
pr. 18	D2	3,927.5	321.3	5,987.5	.02	.656	....	....	....
pr. 19	D2	4,103.8	319.9	5,413.5	.0	.758	....	....	....
pr. 21	D2	2,417.4	318.3	4,487.5	Neg.	.539	....	....	....
an. 13	D3	972.1	306.9	872.7	.123	1.114	.028	58.5	69.6
an. 25	D3	1,838.2	309.2	1,567.5	.078	1.18	.032	62	68.9
pr. 16[1]	D3	3,131.8	325.4	6,355	Neg.	.493	....	....	....
pr. 16[2]	D3	3,132.8	325.5	6,347.5	Neg.	.493	....	....	....
pr. 17	D3[3]	....	....	....	....	....	....	....	....
pr. 18	D3	3,866	321.1	7,425	Small.	.521	....	....	....
pr. 19	D3	2,629.5	319.9	6,525	.0	.403	....	....	....
pr. 21	D3	2,399.2	318.3	5,352.5	Neg.	.448	....	....	....

[1] 11 a. m. [2] 3 p. m. [3] No readings; current too sluggish to turn meter.

D1 below Turner Bridge, 48,000 feet from mouth.
D2 300 feet below Twelfth Street Bridge, 23,300 feet from mouth.
D3 910 feet below Missouri Pacific Bridge, 7,260 feet from mouth.

An interesting bit of light on the method of the run out after the backwater is seen n the observations of April 16, 17, and 18. The Missouri flood reached its crest in the fternoon of April 16. The effect of the run out shows an increased discharge of 3,866 t D3 for April 18, with a drop to 2,629 on the next day, April 19, while at D2, 3 miles rther up stream, the drop from 4,104 to 2,417 does not occur until a day or so later, etween April 19 and April 21.

28. The following table shows the maximum high and minimum low water at the annibal Bridge for each year for which a record was kept:

ABLE IX.—*High and low water at the Hannibal Bridge over the Missouri River at Kansas City, Mo.*

[Elevations refer to St. Louis directrix.]

Year.	Low water.	High water.	Year.	Low water.	High water.
44	....	341.39	1894	305.8	323.30
75	305.9	321.79	1895	305.2	320.00
76	306.3	321.96	1896	306.1	322.40
77	308.1	326.13	1897	304.5	325.80
78	307.7	323.75	1898	307.5	324.80
79	307.0	322.94	1899	308.4	326.50
80	305.5	320.64	1900	307.2	321.00
81	308.5	331.24	1901	307.2	322.70
82	305.1	323.89	1902	306.8	326.50
83	304.5	327.97	1903	306.6	338.30
84	303.7	322.82	1904	305.3	328.40
85	307.5	323.12	1905	305.3	326.20
86	304.1	320.42	1906	305.8	323.00
87	306.4	324.32	1907	307.1	326.90
88	306.9	324.02	1908	306.8	333.50
89	306.7	318.12	1909	306.0	330.20
90	303.9	320.60	1910	304.8	323.50
91	306.0	326.50	1911	305.9	317.30
92	305.0	328.40	1912	307.2	326.60
93	306.6	321.90	1913	305.1	325.50

Mean for years 1875 to 1911, inclusive, 324.61.

29. The flood stages for those years in which bank-full stage—22—at Hannibal ridge has been reached are shown in the following table for the Missouri River at St. seph and Kansas City, and for the Kansas River at Topeka, Kans.

TABLE X.—*Maximum stages during the several floods above bank-full stage at Kansas City, Mo.*

Year	Missouri River.				Kansas River at Topeka.		Estimated discharge of Kansas River.[1]
	Hannibal Bridge.		St. Joseph.		Stage.	Date.	
	Maximum stage	Date.	Stage.	Date.			
1844	37.9	....	(2)	(2)	(2)	(2)	....
1877	22.6	June 10	15.6	June 14	(2)	(2)	....
1881	27.7	Apr. 30	21.8	Apr. 29	(2)	(2)	....
1883	24.5	June 26	17.3	June 26	(2)	(2)	....
1891	23.0	June 30	13.7	June 30	(2)	(2)	36,500
1892	24.9	May 21	12.8	May 20	(2)	(2)	70,000
1897	22.3	Apr. 19	13.2	Apr. 18	(2)	(2)	70,000
1899	23.0	Apr. 28	12.7	Apr. 27	(2)	(2)	32,000
1902	23.0	July 14	13.1	July 13	(2)	(2)	85,500
1903	34.8	June 2	18.7	June 2	32.7	May 30	250,000
1904	24.9	July 8	13.9	Apr. 16	26.5	July 7	137,000
1905	22.7	July 11	16.2	July 11	17.6	July 10	57,000
1907	23.4	July 20	17.3	July 20	12.2	July 20	....
1908	30.0	June 14	18.6	June 15	28.0	June 9	....
1909	26.7	July 13	18.1	July 11	18.3 20.0	July 12 Nov. 15	....
1912	23.1	....	12.9	Apr. 15	17.9	Mar. 21	....
1913	22.0	Apr. 16	....	....	13.6	May 13	....

[1] Estimated from Table XI by assuming discharge at Lawrence to be 97 per cent and at Lecompton 9 per cent of total discharge at the mouth.

[2] No record.

NOTE.—Zero stages at Kansas City and St. Joseph correspond, respectively, to elevations 303.5 and 381. above St. Louis directrix.

30. Further information in regard to the high-water and low-water discharge of the Kansas River is contained in Tables XI, XII, and XIII, below:

TABLE XI.—*Flood data, Kansas River, 1881 to 1905.*

[From United States Geological Water-Supply Papers No. 96, p. 22; No. 147, p. 67; and No. 172, pp. 260, 261

Place.	Year.	Date.	Gauge reading.	Discharge.
			Feet.	*Sec.-ft.*
Lawrence, Kans	1881	Mar. 7	4.2	....
Do	1882	Apr. 10	4.3	....
Do	1883	June 25	4.3	....
Do	1884	May 5	3.8	....
Do	1885	Apr. 27	3.7	....
Do	1886	May 10	4.3	19,37
Do	1887	May 23	2.5	8,84
Do	1888	June 25	3.5	14,29
Do	1889	May 13 July 22	5.0	24,34
Do	1890	Jan. 13	2.8	10,37
Do	1891	June 1	6.0	[1] 35,59
Do	1892	May 16	8.8	[1] 67,71
Do	1893	June 5 July 3	4.3	19,37
Do	1894	June 25	5.3	26,62
Do	1895	June 10 Aug. 19	4.0	17,39
Do	1896	July 20	7.7	[1] 53,30
Do	1897	Apr. 26	8.8	[1] 67,71
Do	1898	June 10	5.6	28,99
Lecompton, Kans	1899	July 8	11.0	30,25
Do	1900	Mar. 10	10.2	24,89
Do	1901	Apr. 14	10.0	25,00
Do	1902	July 15	17.6	81,40
Do	1903	May 31	29.5	233,07
Do	1904	July 7	20.8	130,00
Do	1905	Sept. 18	13.0	54,30

[1] Computed from rating table for period May 16 to Aug. 31, 1896.

ABLE XII.—*Monthly discharge of Kansas River at Lawrence and Lecompton, Kans., for period from 1891 to 1905.*

Month.	Discharge in second-feet.			Month.	Discharge in second-feet.		
	Maximum.	Minimum.	Mean.		Maximum.	Minimum.	Mean.
nuary	14,170	445	2,813	August	58,500	275	7,394
bruary	21,600	275	3,856	September	54,300	692	5,181
arch	25,000	100	5,952	October	42,112	592	3,886
pril	58,000	967	6,650	November	13,320	275	3,444
ay	221,000	787	12,603	December	15,900	507	2,956
ne	205,500	967	15,560				
ly	130,000	275	13,322	Mean			6,978

TABLE XIII.—*Table of monthly discharges of Kansas River.*

Year.	At Lawrence, Kans.			Year.	At Lecompton, Kans.		
	Discharge in second-feet.				Discharge in second-feet.		
	Maximum.	Minimum.	Mean.		Maximum.	Minimum.	Mean.
91	35,750	967	7,228	1899			
92		787	7,222	1900	24,898	2,830	5,527
93	21,440	787	3,617	1901	25,000	275	3,672
94			2,326	1902	81,400	100	11,459
95			3,008	1903	221,000	2,375	18,992
96	53,308	825	6,814	1904	130,000	2,530	10,620
97	58,000	562	4,628	1905	54,300	2,000	11,010
98	28,990	507	3,831				
				Mean [1]			7,140

[1] 1891–1905.

NOTE.—Tables XII and XIII are deduced from the estimated discharges as given in the Water Supply pers of the United States Geological Survey.

This gives a mean monthly discharge at the mouth of 7,427 cubic feet per second.

31. The Kansas River watershed is about 60,000 square miles, as shown in Table IV, taken from the report of the 1904 Board of Engineers. (P. 9, S. Doc. 160, 58th ng., 2d sess.)

TABLE XIV.—*Kansas River watershed.*

	Square miles.
ig Blue River	9,450
epublican River	23,776
lomon River	6,590
line Fork	3,230
noky Hill River	8,085
cal Kaw drainage	6,867
Total	57,998

32. The low-water flow usually occurs in December or January, during very cold eather, and is usually from 500 to 3,000 second-feet. The minimum on record is the timated discharge of 100 second-feet, in March, 1902. Excluding the months of ecember and January, the mean discharge for the low-water month of the navigation ason is 3,444, at Lawrence and Lecompton, or about 3,600 at the mouth.

33. The high-water flow occurs, as a rule, between May 1 and July 1, and is usually m 25,000 to 75,000. The maximum discharge occurred in the flood of 1903 and is timated at 250,000 second-feet by the United States Geological Survey and at from 0,000 to 350,000 by the United States Engineer Board of 1904. The 1904 flood has en estimated by Mr. Robert Moore, a consulting engineer employed by certain terests, and also by the Geological Survey, at about 137,000 second-feet. From the peka gauge heights, Table X, and assuming the discharge to be directly proportional the gauge heights, the 1908 flood would seem to have a discharge of about 170,000 cond-feet.

34. The velocities in the stretch from Turner to the mouth vary from zero or even negative to an estimated velocity of 10 feet per second for flood stage in the new regulated channel. (Appendix B, H. Doc. No. 94, 62d Cong., 1st sess.)

We see, however, that the velocity within this stretch of river does not always increase with the stage but depends on the relative stages of the Missouri and Kansas Rivers, and that even at bank-full stage in the Missouri, the surface of the Kansas River has a zero or even a negative slope. This fact has an important bearing on the question of maintenance of an improved channel, and also upon the question of the scour at flood stage contemplated by the drainage project.

35. The fluctuations of the water surface in the mouth of the river are shown graphically for the stock yards gauge for the years 1901 to 1908, figure 4, Appendix C, and at the several gauges established for the present survey and covering the period from the middle of January to the end of June, 1913. (Fig. 5, Appendix C, and Table XVI.) Information in regard to the stock yards readings for the years 1908, 1909, and 1910, was tabulated in the former report and is here shown as Table XV.

TABLE XV.—*Summary of gauge readings, Stock Yards Bridge, 1908–1910.*

[Zero of gauge 309.30 above St. Louis. Standard low water, 311.5.]

	1908	1909	Jan. 1–Oct. 27, 1910.
Mean stage	315.17	315.23	315.37
Maximum stage	338.94	333.34	326.0
Date of maximum stage	June 15.	July 12.	Mar. 24.
Minimum stage	310.34	309.34	309.3
Date of minimum stage	Oct. 20.	Jan. 7.	Oct. 18.
Mean stages by months:			
January	311.08	310.07	317.9
February	311.65	313.05	314.4
March	314.42	317.74	319.4
April	316.19	316.18	314.4
May	317.92	315.60	317.5
June	331.67	323.77	317.5
July	323.34	326.21	313.2
August	317.71	315.71	312.6
September	312.78	314.41	314.4
October	311.58	311.81	311.0
November	313.07	315.64	....
December	310.39	316.27	....

The principal characteristics of the 1913 readings are shown in Table XVI.

TABLE XVI.—*Summary of gauge readings, Jan. 12 to June 28, 1913.*

Location.	Hannibal Bridge.	James Street Bridge.	Twelfth Street Bridge.	West Kansas Avenue Bridge.	Turner Bridge.
Standard low water	308.67	309.73	315.45	317.67	323.3
Mean stage	314.2	315.3	315.9	316.6	323.5
Maximum stage	325.5	327.7	327.4	327.5	330.6
Date of maximum stage	Apr. 16	Apr. 16	Apr. 15	Apr. 16	May 1
Minimum stage	305.2	[1] 307.6	309.7	[2] 311.1	321.3
Date of minimum stage	Jan. 11	[3] Jan. 12	Feb. 5	Feb. 4	Jan. 2
Mean stage by months:					
Part of January	308.3	[1] 309.3	310.8	[2] 312.1	321.8
February	310.4	310.5	311.5	[2] 312.5	322.1
March	311.5	312.5	313.3	[2] 314.1	323.0
April	317.8	319.1	319.1	319.2	324.0
May	316.8	318.0	318.9	319.7	326.0
June 1 to June 28	318.3	319.5	319.6	319.9	323.3

[1] At Central Avenue gauge.

[2] Readings at West Kansas Avenue are estimated for dates prior to Mar. 25.

[3] No reading prior to Jan. 12.

36. The slopes to correspond to the above mean stages are given in the following ıble:

TABLE XVII.—*Mean slopes Kansas River, Jan. 12 to June 28, 1913.*

	Hannibal Bridge to James Street.		James Street to Twelfth Street.		Twelfth Street to West Kansas Avenue.		West Kansas Avenue to Turner.	
	Per 1,000 feet.	Per mile.	Per 1,000 feet.	Per mile.	Per 1,000 feet.	Per mile.	Per 1,000 feet.	Per mile.
nuary to June (approximate)........	0.12	0.64	0.03	0.15	.009	0.45	0.37	1.96
nuary (last half)...	....	....	....	....	.16	.83	.52	2.76
ebruary............	.01	.05	.05	.25	.12	.64	.52	2.73
arch............	.11	.58	.04	.21	.10	.51	.48	2.53
pril............	.14	.76	.00	.00	.012	.06	.26	1.37
ay............	.13	.70	.04	.23	.10	.51	.34	1.79
ne 1 to 28..........	.13	.70	.005	.03	.04	.19	.18	.97

LOCATION OF WRECKAGE AND OTHER OBSTRUCTIONS.

37. During the extreme low water in January sketches were made from the bank show the general location of such old bridge spans, piers, piles, and other wreckage was visible at low water. Later in the course of the survey a party was organized make probings to locate as much of the submerged wreckage as practicable. This ırty worked from a small barge, probing into the mud and sand with sharpened on rods about 1¼ inches in diameter and 16 feet long. The barge was pulled by pe back and forth across stream, the two probers working continuously. When object was struck by the rod a stadia reading of the location was taken by a transit an on shore. The nature of the object, whether stone, metal, or wood, could be etermined by the sound and the feel. The distance between the probing ranges averged about 350 feet, but varied depending upon the nearness to the possible location an old wreck. It was manifestly impossible to probe over every square yard of ver bottom, so that it is possible that the party failed to locate about 15 per cent of e submerged wreckage. There were only a very few bridge spans of which no ace was found.

38. Table XVIII gives the location and a brief description of the several wrecks ıd obstructions. Their approximate locations are shown on the map. (Q 375.)

TABLE XVIII.—*Obstructions, Kansas River.*

).	Description.	Location.
	2 snags..........	Near left bank, about 100 feet from boat yards.
	Remains of old United States pile dike, 13 piles.	Right bank near △ 72.
	Old barge, 40 by 20 by 3 feet..........	Do.
	Snags, 18-inch log..........	Below center pier of Chicago Great Western bridge.
	Snags..........	Near right bank at pier of Chicago Great Western bridge.
	Piles and drift, about 5 piles..........	Near center pier of Chicago Great Western bridge.
	Remains of old pier of Kansas City Northwestern Ry. bridge, consisting of 2 steel cylinders filled with concrete; riprap stone and 100 piles. About 400 cubic yards of stone.	180 feet above center line of Chicago Great Western bridge and 50 feet from left bank.
	Rock and iron from old bridge. Probably span of old Kansas City Northwestern Ry. bridge.	100 feet above Chicago Great Western bridge about midstream.
	Remains of old stone pier and bridge iron from Kansas City Northwestern.	180 feet from center line of Chicago Great Western bridge and 100 feet from right bank.
	2 piers of old Metropolitan Bridge..........	North pier is outside of harbor line; second pier near water's edge, left bank.
	Remains of pier of Metropolitan Bridge..........	On right bank near water's edge.
	Piers of Flow Line Bridge:	
	(a) West abutment..........	Left bank, within harbor line.
	(b) Center pier..........	Near midstream.
	(c) East abutment..........	Right bank, near water's edge.
	Old barge..........	Near left bank under James Street Bridge.
	2 or more piles..........	Near center of north span of James Street Bridge.
	....do..........	About 50 feet below east span of James Street Bridge.
	Old pier of James Street Bridge..........	

[1] Not drawn on map.

TABLE XVIII.—*Obstructions, Kansas River*—Continued.

No.	Description.	Location.
17	Rock and pile dike	Right bank, about 600 feet below Kansas Cit Southern Ry. bridge.
18	....do	Do.
19	Cluster of 20 piles	560 feet below Kansas City Southern bridge, mid stream.
20	Cluster of about 15 piles	500 feet below Kansas City Southern bridge, 50 fee from right bank.
21	Piles and riprap around piles, Kansas City Southern bridge abutment and piers	Under Kansas City Southern bridge.
22	Snags	Left bank about 600 feet below Kansas City Southern bridge.
23	Railroad trestle	From west abutment, Kansas City Southern bridg to harbor line.
24	Old pile dike, about 20 piles	Left bank near △ 59.
25	Old pile dike, about 10 piles	Left bank, about 300 feet below Central Avenu Bridge.
26	Bridge span	460 feet below Central Avenue Bridge, and 100 fee from right bank.
27	Box car or old barge	Do.
28	Part of span Central Avenue Bridge	400 feet below Central Avenue Bridge, and 300 fee from right bank.
29	Part of span of Central Avenue Bridge and remains of car.	300 feet below Central Avenue Bridge, and nea water's edge, left bank.
30	Old concrete bin	100 feet below Central Avenue Bridge, and nea harbor line, left bank.
31	Present piers of Central Avenue Bridge	5,721 feet from mouth.
32	About 20 piles	Under Central Avenue Bridge.
33	One steel tube	Upper side, first pier from left bank, Central Avenu Bridge.
34	Sunken barge	At water's edge, 100 feet above Central Avenu Bridge, left bank.
35	Old bridge iron	250 feet above Central Avenue Bridge, 190 feet fror left bank.
36	Piles	Below center pier, Missouri Pacific bridge.
37	Remains of Union Pacific bridge piers	Under present Union Pacific bridge.
	(*a*) First pier from left bank	Do.
	(*b*) Second pier from left bank	Do.
	(*c*) First pier from right bank	Do.
	(*d*) Scattered pile and rock	Do.
38	Old bridge iron	At center pier, Union Pacific bridge.
39	Old bridge iron, about 1 span	Near left bank under Union Pacific bridge.
40	Rock dikes	Right bank below stockyards bridge.
41	1 pile	About 200 feet below stockyards bridge and abou 200 feet from right bank.
42	Lower stockyards bridge piles and riprap around abutments.	8,564 feet from mouth.
43	Wreck of box car	125 feet below Chicago, Rock Island & Pacif bridge and 250 feet from right bank.
44	West abutment of old upper stockyards bridge.	On left bank at bridge site.
45	Remains of piers and riprap, old stockyards bridge.	Pier No. 1 from left bank.
46	....do	Pier No. 2 from left bank.
47	Sunken box car	About 25 feet northeast pier 2 from left bank.
48	East abutment of old upper stockyards bridge	On right bank at bridge site.
49 50	Remains of 4 or 5 spans of Chicago, Rock Island & Pacific bridge, East Kansas Avenue Bridge, and possibly 1 span of Belt Line. Tangled mass of bridge iron.	About 80 feet below Chicago, Rock Island & Pacif Bridge.
	Remains of Chicago, Rock Island & Pacific bridge:	
51	First pier from right bank	Under present Chicago, Rock Island & Pacif bridge, 205 feet from left bank.
52	Second pier from right bank	Under present Chicago, Rock Island & Pacif bridge, 180 feet from left bank.
53	Third pier from right bank	Under present Chicago, Rock Island & Pacif bridge, 210 feet from right harbor line.
54	Sunken barge	Below second pier from left bank, East Kans Avenue Bridge.
55	Two sunken box cars	About 2,200 feet above East Kansas Avenue Brid near right bank.
56	One sunken box car	About 260 feet below Kansas City Belt Line brid in channel, about 100 feet from right bank.
57	Piles and rock	About 300 feet above East Kansas Avenue Brid near left bank.
[1] 58	3 spans, Kansas City Belt Line bridge	Not found.
59	Remains of first pier from left bank of old Kansas City Belt Line bridge.	About 250 feet from left harbor line.
60	Probably old car	About 275 feet from left harbor line, center line bridge.

[1] Not indicated on the map.

Table XVIII.—*Obstructions, Kansas River*—Continued.

Jo.	Description.	Location.
61	Old pier No. 2, Kansas City Belt Line Bridge..	About 400 feet from left harbor line, center line of bridge.
62	Riprap around new pier	Center pier, Belt Line Bridge.
63	Timber structure, probably sheet piles	About 40 feet east of center pier, Belt Line Bridge.
64	Old pier No. 3, Kansas City Belt Line Bridge..	About 470 feet east of left harbor line on center line of Belt Line Bridge.
65	Old pier No. 4, Kansas City Belt Line Bridge..	Center line of present bridge near right bank.
66	Piling near old pier No. 4	
67	One span, old Fifth Street Bridge	400 feet below Fifth Street Bridge, 150 feet from right bank.
68	.....do	400 feet below Fifth Street Bridge, 80 feet from right bank.
69	.....do	200 feet below Fifth Street Bridge, 300 feet from right bank.
70	Remains of trestle for sand pump	200 feet above Fifth Street Bridge, near water's edge, left bank.
71	Cluster of piles	200 feet above Fifth Street Bridge, 200 feet from right bank
72	Rock dikes	Right bank from Fifth Street Bridge to Twelfth Street Bridge.
73	Old iron from Twelfth Street Bridge	600 feet below Twelfth Street Bridge, 100 feet from right bank.
74	.....do	500 feet below Twelfth Street Bridge, 300 feet from right bank.
75	About 10 piles	Foot of pier, left bank, Twelfth Street Bridge.
76	Old rock dikes, about 16	On right bank, from Twelfth Street Bridge to old Kansas City Southern Bridge.
77	Intake dock	Right bank, midway between Twelfth Street Bridge and Argentine Bridge.
78	Cluster of about 10 piles	On left bank, opposite pumping station.
79	Remains of rock dike and about 10 piles	1,100 feet below Argentine Bridge, near left bank.
0	Cluster of piles	600 feet below Argentine Bridge, near right bank.
1	Cluster of 12 piles	600 feet below Argentine Bridge, near left bank.
2	Old bridge iron from Argentine and Kansas City Southern bridges.	600 feet below Argentine Bridge, 100 feet from right bank.
3	Part of span of Argentine Bridge and small part of Kansas City Southern Bridge.	Right bank, about 25 feet from piers of Kansas City Southern Bridge.
4	Piling and remains of old trestle	Near left harbor line on center line of Kansas City Southern Bridge.
5	Remains of old Kansas City Southern Bridge spans.	Near old piers, Kansas City Southern Bridge, left bank.
6	Overturned steel tubes from Kansas City Southern Bridge.	Center line of Kansas City Southern Bridge, midstream.
7	Span of Argentine wagon bridge	Do.
8	Riprap and upright tubes	Kansas City Southern Bridge site, left bank.
9	.....do	Kansas City Southern Bridge site, right bank.
0 1	Riprap and two overturned masonry piers, Argentine Bridge.	Old bridge site.
2	Old piers, West Kansas Avenue Bridge	Center line of present bridge.
3	Cinder heap	On right bank above West Kansas Avenue Bridge.
4	.....do	Do.
5	Piles of rock	In channel, about 2,000 feet below Turner Bridge.
6	.....do	Do.
7	Stump	About 1,500 feet below Turner Bridge.
8	.....do	Do.
9	Four spans old Turner Bridge	About 300 feet below Turner Bridge.

BLUE CLAY STRATUM.

39. The contractors removing the old piers of the Union Pacific bridge stated that ey had met with considerable difficulty because of a stratum of stiff blue clay a short stance below bottom of the channel. As the location of this stratum might affect e cost of removing old piers and cost of dredging, several lines of wash borings were ade in the section between the Missouri Pacific bridge and the James Street Bridge. he results are shown on print Q. 376/4. From this it is seen that this stratum at the issouri Pacific bridge is about 2 feet above scour line near the right bank and is bout on the same level as the scour line from the left bank to about 200 feet from the ght harbor line. At Central Avenue Bridge this stratum is from 2½ to 3 feet above our line. At the James Street section the blue clay has ended. This stratum lies low the bottom of the navigable channel, so does not affect this project from the andpoint of navigation. It would, however, have a tendency to limit the bottom our contemplated by the drainage project. This small section above scour line was t, however, considered in making up the estimates of the amounts of dredging.

ESTIMATES OF YARDAGE.

40. For the purpose of estimating and for office study, tentative channel lines wer laid out, the location being determined with a view to obtaining the minimum excavation and at the same time giving consideration to the position of existing and proposed bridge piers, avoiding abrupt turns, and conforming in general to the presen channel. The blue prints showing these channel lines are on file in this office.

41. The approximate mid-channel distances from the mouth to the several bridge are as follows:

TABLE XIX.—*Channel distances.*

Name of bridge	Distance from mouth.	Name of bridge.	Distanc from mouth.
	Feet.		*Feet.*
Edgewater	1,336	Stock yards	9,1
Chicago Great Western Ry	1,578	Chicago, Rock Island & Pacific Ry	10,6
Kansas City Viaduct & Terminal Ry	2,131	East Kansas Avenue	11,1
James Street	2,881	Kansas City Belt Ry	13,7
Kansas City Southern Ry	4,781	Fifth Street	17,5
Central Avenue	6,348	Twelfth Street	23,5
Missouri Pacific Ry	8,171	Argentine	28,2
Union Pacific Ry	8,271	West Kansas Avenue	31,8

42. In order to study the several possible projects and to arrive at a proper unde standing of the extent of cooperation that should be expected from the Kaw Valle Drainage Board, estimates of required excavation were made as follows:

(1) To obtain a 4-foot channel from the mouth to West Kansas Avenue Bridge.

(2) To obtain a 6-foot channel up to the Belt Line Bridge and a 4-foot channel thenc to the West Kansas Avenue Bridge.

(3) To obtain a 6-foot channel over the entire stretch to be improved.

(4) To remove all earth within the levees and above standard low water. (Quanti A, sheet No. Q. 376/3.)

(5) To remove all earth within the levees and above scour line. (Quantity C.)

For dredging under water an additional foot of depth was allowed.

43. The following method was used in computing the yardage. Cross sectio between the levee lines were plotted on a scale of 1 inch equals 20 feet for each of sounding ranges between the mouth and West Kansas Avenue Bridge. The are for A and B (see sheet Q. 376/3) and the areas within the channel were measured b planimeter at each cross section. To determine the total volume A, the area in ran 1 was added to area in range 2 and the mean considered as the mean sectional are The distance between the ends of the sections was scaled along each harbor line a the mean taken as the mean distance. The product of the mean area by the me distance gave the volume of the prism. The same was done for the sections at ran 2 and range 3, range 3 and range 4, and so on. The sum of these volumes gives t total volume.

44. Volume B was computed the same way by using the mean harbor-line distanc

45. The areas of the standard sections C and D were computed and the volur obtained by multiplying by the mean of the entire right and the entire left harb line distance. Subtracting volume B, the water prism, from C plus D, we obtain t amount to be excavated between the levee lines, the standard low-water plane. a the scour line. Add to this quantity A, and we have the total excavation requir to clean out the flood waterway.

46. The amounts of excavation required for the 4-foot and for the 6-foot chann were computed similarly, except that the mean channel-line distance was used inste of the harbor-line distances, and 60 cross sections instead of 53.

47. These quantities total as follows:

Reference mark.	Description.	Cubic yards.
A	Amount above standard low water	2,851,
C+D−B	Below standard low water and above scour line	7,439,
A+C+D−B	Total within levee lines and down to scour line	10,290,
1	For 4-foot channel, mouth to West Kansas Avenue	106,
2	6-foot channel, mouth to Belt Line Bridge; and 4-foot channel, Belt Line Bridge to West Kansas Avenue Bridge.	229,
3	6-foot channel, mouth to West Kansas Avenue	341,

48. The amount of silt brought down by the Kansas River is estimated by the United States Geological Survey to be over 21,000,000 cubic yards annually, and over 80 per per cent of this occurs in the months April to July, inclusive. Further data are given n paragraph 13 and Appendix C of the 1910 report. (H. Doc. 94, 62d Cong., 2d sess.)

BRIDGES.

49. Data concerning the bridges over the Kansas River are found on page 14 of the ormer report (H. Doc. 94, 62d Cong., 1st sess.) and in the report on the preliminary xamination, dated November 27, 1912. Plans have been approved for the recontruction of the bridges at Central Avenue and at East Kansas Avenue and for buildng a highway bridge at the site of the old Argentine Wagon Bridge. The new West Kansas Avenue Highway Bridge has been completed.

50. The former report stated in paragraph 19:

"It will be seen that with the bridges raised and the levees built, the clearance of ridge above standard low water will be 30 feet. The mean yearly stage is about feet above low water, so that generally 26 feet clearance would be available and xcept for short flood periods 20 feet would be available, corresponding to a 10-foot tage. With this clearance, gasoline power boats can readily be built to operate on he river for towing barges to and from the river front."

RIPARIAN ENCROACHMENTS.

51. The establishment of harbor lines in 1910 has prevented further encroachments. he removal of such former encroachments as now lie within the harbor line has been ndertaken by the Kaw Valley Drainage Board. The navigation interests are not aterially affected otherwise than by the floods that have resulted in recent years.

REMOVAL OF OBSTRUCTIONS.

Location.

52. The question of removing the wreckage and other obstructions is one of the reatest importance, and for that reason it was especially attempted to locate the osition of all the existing débris and as far as practicable to determine the parties sponsible. It is estimated that by the methods used at least 85 per cent of the reckage now in the bed of the river was found and noted.

53. The results of this survey are tabulated in Table XVIII and the locations are hown on the general map. (Q. 375/1-8).

Legal aspects.

54. The legal status of these obstructions has been the subject of much discussion. has been a question whether the Federal Government had the authority to force he removal of these obstructions at the expense of the bridge owners and whether, ven if the authority is sufficient, it would be advisable to take such action in view of e limited navigation and the large cost of such removal. The local drainage board eems to have held off in the hopes that the Federal Government would take the necsary steps. In order to arrive at some definite conclusion as to the legal status a udy of the available records and statutes was made and a report, dated May 20, 1913, as submitted to the district officer, as follows:

55. *Statement of the case.*—The Kansas River lies wholly within the State of Kansas nd at one time was declared nonnavigable by the Kansas Legislature. This act has nce been repealed. This river practically separates Kansas City, Mo., from Kansas ty, Kans., so there have been built a number of highway and street car bridges nnecting the two cities. In addition, most of the railroads running west from ansas City have bridged this river near its mouth. So by 1903 there had been conucted from time to time within the first 6 miles above the mouth eight highway idges, seven railway bridges, one aqueduct, and two stock-yard bridges.

56. These bridges appear in general to have been constructed without charter or thority. On the other hand, there appears to have been no protest on the part of vigation interests or the Federal Government prior to 1903 against the location, nstruction, or design of these bridges, although they were constructed with so little adroom and the channel was so narrowed by riprap around the piers as to make any vigation on the river very difficult.

57. In May and June, 1903, there occurred an unusually heavy rainfall. The nsas River was in flood, and its mouth being obstructed by bridges, riparian enoachments, and other obstructions the water reached an almost unprecedented

height. The results were disastrous to the manufacturing section of Kansas City With the single exception of the Missouri Pacific bridge, all the bridges were destroyed and their spans, and in some cases the piers, were left in the bed of the river The remains of these bridges and piers now lie within the bed of this river, offerin dangerous obstructions to navigation and preventing the scouring of the bed at hig water, thus enhancing the danger from floods.

58. In the following summer there occurred another flood of little less magnitude and again in 1908 and 1909 the high water did more or less damage.

59. To protect themselves against further damage the people residing or ownin property in the threatened area organized themselves in 1905 into a drainage distric under the laws of the State of Kansas. This organization is administered by a boar of directors known as the Kaw Valley Drainage Board. This board has authorit under the State laws—

"to take charge of and exercise exclusive control over natural water courses withi its territorial limits in the interest of flood protection, and may condemn and caus obstructions in such water courses to be removed."

And the law further authorizes the district—

"to have all obstructions wrongfully placed in the channel of natural water course adjudged public nuisances and abated as such," and "to prescribe, regulate, and fi the height of the superstructures above the water, the length of all spans and th location of the piers of all bridges across water courses situated in the district."

60. The question now to be determined is who shall remove or cause the remov of these obstructions, the Kaw Valley Drainage Board or the Federal Governmen and who shall pay the costs of this removal, the United States, the Kaw Valley drain age district, or the parties responsible for the existence of these obstructions.

61. It would seem from the laws of Kansas, quoted in paragraph 5 above, that th drainage board has ample authority to proceed under the laws of the State to hav these obstructions "adjudged public nuisances and abated as such." The Kans City Southern case has recently been tried under this law and the right of the Ka Valley Drainage Board to regulate the height of superstructures and the length spans and the location of piers of all bridges has been upheld by the State suprem court. This case is now before the United States Supreme Court on appeal by th Kansas City Southern Railroad Co. For some reason the drainage board has bee loth to institute proceedings in the State courts but has repeatedly requested th Federal Government, through the War Department and the Department of Justic to take action in the premises.

62. *History of case.*—Following the flood of 1903 a board of engineers was appoint by the Chief of Engineers to consider and report upon the harbor lines at Kans City, the obstructive bridges in the Kansas River, and flood conditions in the Kans River. For this report see Senate Document No. 160, Fifty-eighth Congress, seco session. This board considered the Kansas River a navigable stream and reco mended active control by the Federal Government and the enforcement of "t statutes and regulations relating to the protection of navigable waterways." 1904 and 1905 complaint was made to the Department of Justice against many of the bridges. After considerable correspondence the suit against the Chicago Gre Western Railroad Co. was withdrawn in June, 1905. The suits against the Belt Lin the Stock Yards, and Rock Island Railroad companies were dismissed upon the su mission of plans for new bridges approved by the Secretary of War, with the und standing that all obstructions caused by the former bridges had been or would be moved to below the point of possible scour. The remaining cases against the Misso Pacific and Union Pacific Railroad companies were tried before United States C cuit Court, District of Kansas. The court found—

"that the Kansas River from its mouth to a point several miles above the city Argentine is a navigable stream and that the bridge of the defendant as now co structed and maintained is an obstruction to the navigation thereof."

The court required the bridge to be raised and widened, and "that all piling, r rapping, and other similar obstructions in the channel of the stream under said bric be removed."

Thus was established by a judicial decision the fact that the Kansas River i navigable stream and under the jurisdiction of the War Department.

63. Since that time the question of causing the removal of further obstructions l been brought up from time to time. Attention is invited to the following correspo ence: (E. D. 55336/42, 48993/95, 48993/97, 48993/98, 55061/3, 55336/24, 25, 42, 45, 47, 49, 55336/63, 64.)

64. This matter was again referred to the War Department by the Department Justice. In the second indorsement on the Attorney General's letter, the Chief Engineers stated that—

“The litigation desired is not primarily for the benefit of navigation but by enforc-
ng the removal of encroaching structures to increase the flood-discharge capacity of
he river and secure immunity from the recurrence of disastrous floods. This pur-
ose is undoubtedly important and commendable and I am of the opinion that the
Var Department may very properly lend the Department of Justice such support
nd assistance as may be practicable in the prosecution of any suits that may be
rought by that Department to secure, for the public benefit, the abatement of
uisances and the betterment of conditions in the Kansas River.”

The Secretary of War stated an opinion of similar tenor, but went further, stating—

“The removal of these artificial obstructions, however, will have a direct and sub-
antial, beneficial effect upon the navigability of the river by enlarging and improving
s natural channel. The Kaw River is a navigable waterway of the United States
ithin the meaning of the Federal Statutes relating to navigable waters and the
ructures herein referred to affect injuriously the navigable channel of said waterway.”

65. In a memorandum to the Attorney General of January 9, 1909, Mr. A. A. Rich-
ds of the Department of Justice submits a summary of the entire case and recom-
ends “that the parties responsible for their existence be required to clear the channel
all solid obstructions now found therein,” and considers that sections 9 and 18 of
e rivers and harbors act of March 3, 1899, confers ample authority upon the War
epartment and the Department of Justice to compel the removal of all obstructions
the Kansas River by and at the expense of those who placed them there.

66. The Attorney General in February, 1909, instructed the district attorney at
opeka to—

institute suits for the removal or reconstruction of all bridges over the Kansas River
ithin the corporate limits of Kansas City, Kans., which have not been constructed
accordance with plans approved by your (the War) department; also suits against
l persons responsible for the existence of obstructions in the channel of said river;
d also suits against all persons who have encroached upon the banks of said river.”

The establishment of harbor lines under special act of Congress and the approval of
ese lines by the Secretary of War in 1910 practically cleared the situation as far as
parian encroachments are concerned, and removed the cause for action in many of
e cases under investigation. Since that time no further action has been taken by
e Department of Justice to enforce the removal of the bridge wreckage.

67. The Kansas City Southern case is the final case in regard to this question. (June
, 1912.) The decision in this case indicates the attitude of the department as
vorable only to such steps as are taken for the removal of actual and unreasonable
structions to the existing navigation. The Kaw Valley Drainage Board has carried
is case to the Supreme Court of the State of Kansas and there established the right
the board to supervise bridges, etc., over the Kansas River in the interest of flood
otection. This case is now pending before the United States Supreme Court.

68. The present phase of the question is presented by the river and harbor act of
ly 25, 1912, directing a preliminary examination of the Kansas River from the mouth
the western limits of Kansas City, Kans., with a view to removing all obstructions
erefrom, dredging and widening the mouth and extending the improvements so as
fit the same for navigation, and to consider propositions for cooperation on the part
local authorities and interests.

69. *Statutes.*—Statutes pertaining to obstructive bridges over navigable waters are
und as follows:

River and harbor acts of 1884, 1888, 1890, 1894, 1899, and act of March 23, 1906.
e act of 1906 (R. S. 34, ch. 1130, p. 84) would seem to be limited in its applica-
n to only those bridges constructed after the date of passage of the act; but is of
lue, however, inasmuch as the first provision in section 4 against unreasonable
structions to free navigation helps to indicate the intent of the other laws upon
is subject. The statute which now applies to the present case is found in the
er and harbor act of March 3, 1899; from which it would seem that action against
e bridge companies could lie under provisions of section 10, for the creation of
authorized obstructions to the navigable capacity of the waters of the United
ates; under section 13, for depositing material on the banks of a navigable stream
that the same was washed into the stream, thereby impeding and obstructing
vigation; or under paragraph 18 for constructing a bridge that has become an
reasonable obstruction to free navigation, by reason of “insufficient height and
herwise.”

0. In addition to the strict letter of the law, the spirit and intent of the law
ld be invoked. The determination of this intent would be from a study of the
r as a whole and from the interpretation placed upon this law and others of similar

nature by the courts. The intent of Congress as determined from the law as a whole seems to have been to prevent the unreasonable obstruction of navigable streams and to confer all the necessary powers upon the proper agents of the Governmen to accomplish this purpose. The interpretation of the spirit of this law and the extent of its application may be arrived at from the decision of the United States Supreme Court in the case of the Union Bridge Co. *v.* the United States. (Occasional Papers, No. 25, Engineer School.) In this case the constitutionality of the law (act of Mar. 3, 1899) is established and though the entire discussion refers to the constitutional right of the United States to enact such a law, the words of the cour are nevertheless of great weight in determining the spirit, intent, and applicatio of this law; and for this purpose certain passages of this decision are quoted o referred to as follows:

"It has long been the policy of the Government to remove such unreasonable obstructions to the free navigation of the waterways of the United States as were caused b bridges maintained over them. That such an object was of common interest an within the competency, under its power to regulate commerce, everyone mus admit * * *.

"By the statute in question (act of Mar. 3, 1899), Congress declared in effect tha navigation should be freed from unreasonable obstructions arising from bridges insufficient height, width of span, or other defects. It stopped, however, with th declaration of a general rule and imposed upon the Secretary of War the duty of asce taining what particular case came within the rule prescribed by Congress, as well a the duty of enforcing the rule in such cases.

"'The duty of a railroad to restore a stream or highway which is crossed by the lin of its road is a continuing duty; and if the crossing becomes inadequate to meet th new and altered conditions of the country, it is the duty of the railroad to make suc alterations as will meet the present needs of the public.'

"Some stress was laid in argument upon the fact that compliance with the order the Secretary of War will compel the bridge company to make a large expenditure money. But that consideration can not affect the decision of the questions of th constitutional law involved."

Attention is also invited to the remarks of the court upon the cases of the Ne Orleans Gas Light Co., the Chicago, Burlington & Quincy Railroad Co., and the We Chicago Street Railway Co.

71. In addition to the above cases, we have the opinion expressed in memorandu from the Attorney General's office expressing the opinion that sections 9 and 18 of a of March 3, 1899, conferred ample authority upon the War Department and the Depa ment of Justice to compel the removal of all obstructions by and at the expense of tho who placed them there. (E. D. 55336/49.) And further, we have the decision the United States District Court in the Union Pacific case (No. 8296, United Stat Circuit Court, District of Kansas, First Division), requiring the removal of the pilin riprapping, and other similar obstructions, "so that the channel may be left free scour and lower itself," and his decision requiring the Rock Island Railway Co. "remove all materials and obstructions placed by it in the channel of the Kans River at the time of the building of the abutments and piers of its present bridge."

72. *Discussion.*—There is still further an aspect of this case that should have weig in deciding this question, and it is that these bridges, constructed without authori or charter, should be subject to the same provisions and restrictions that usually p tain to the bridges that are constructed under proper authority and under chart These charters usually contain a provision requiring the bridge company to mainta a free navigable channel through and under the bridge, or to so maintain the brid that it does not become an unreasonable obstruction to navigation. Should, then, th bridge companies, who, without authority and illegally, have constructed brid over the Kansas River, a navigable waterway of the United States, be able to cla special immunity and privileges by reason of their very violation of the law? Fr the remarks of the court in the Union Bridge case, we see that a bridge, though c structed by authority of a State, and whether or not an unreasonable obstruction navigation at the time of its erection, is subject to the paramount power of Congr to protect navigation against unreasonable obstructions. So also must a bridge c structed without permission or authority of any State or of the United States be subj to such power.

73. Along this same line the court stated further:

"Independent of the grounds upon which we thus place our decision, it is app priate to observe that the conclusion reached finds support in the charter of the bri company and in the law of Pennsylvania as declared by its highest court. The char of the company, as we have seen, expressly warned the company that its bridge m not obstruct navigation—that is, in legal effect, navigation as it then was or might at any subsequent time."

Such a requirement is contained, expressed, or implied in every charter granted y a State or by the United States for the construction of a bridge over a navigable aterway. Should not, then, these bridges constructed without charter or authority e subject to the same obligation to maintain free and unobstructed navigation? ertainly they can not claim immunity from restrictions that pertain to those bridges hat have a proper charter. In other words, the construction of these bridges over the Kansas River without authority, their continued use up to the time of their destruction, nd the acquiescence of the Federal authorities without protest, has established certain bligations on the part of the bridge owners and the Government that can best be xpressed by the general form of bridge charter as issued to bridges in this vicinity.

74. Furthermore, these bridge companies occupy the position of trespassers. Granted that they were acting in good faith and under the impression that the Kansas River was not a navigable stream, they are as trespassers nevertheless, and as such are esponsible for the damages resulting from such trespass, and are under obligation to ake such means as may be necessary to minimize the resulting damage to navigation nd danger to life and property.

75. The bridge companies may maintain that they should be required to remove nly that part of the wreckage that lies within the limits of the navigable channel and nly to the bottom of a possible 6-foot channel, and not all the way down to scour line. Our right to require the complete removal of all wreckage within the river bed and to point below possible scour seems to have been established by decision of the United tates district court in the Union Pacific and Rock Island cases. The danger to light raft boats, offered by unmarked and submerged wrecks, such as now lie in the Kansas River, makes it advisable and proper in the interests of navigation to require the removal of all structures that would be completely submerged at any navigable stage nd at least to the depth of 7 feet below the mean low-water plane. In view of the ffect these obstructions have upon prolonging the flood stage and thereby decreasing o some extent the time that boats may pass under the bridges, in view of the disastrous effects of floods in this river upon property and lives, and in view of the unauthorized position occupied by the bridge owners, it is demed proper and just to insist upon the removal of these obstructions to scour line.

76. It will also be argued that the cost of such removal is great compared to the small dvantages derived therefrom. This as a question of fact is debatable. Even if true, he question of cost is entitled only to limited consideration. These companies by the onstruction and maintenance of bridges over this stream assume certain responsibility or the results of such construction and maintenance, and the cost to them of avoiding he invasion of private rights or of doing damage to other parties is not of especial oncern to the Federal Government.

77. From a consideration of the foregoing, it is believed that—

(*a*) The United States has ample authority, under sections 10, 13, and 18 of the river and harbor act of March 3, 1899, to compel the removal, by and at the expense of he responsible parties, of all obstructions that unreasonably impede or obstruct navigation.

(*b*) That the Kaw Valley Drainage Board has ample authority, under the laws of he State of Kansas and in the interest of flood protection, to have these obstructions adjudged public nuisances and abated as such.

(*c*) That those bridge owners, by the construction and maintenance of bridges over his stream, either with or without a charter, assume thereby the responsibility for damages resulting from such construction and maintenance and an obligation at whatever cost not to invade private rights nor to impede or obstruct navigation.

78. If the above interpretation of the law be correct, it would hardly be believed that the bridge owners would resist an order for the removal of all unreasonable obstructions. Satisfactory and amicable results may possibly be obtained by opening negotiations with these companies as to whether they would prefer themselves to remove the wreckage or to cooperate with the Federal Government in the removal of all obstructions, this office to take charge of the work and the owners of each bridge to cooperate to the extent of the estimated cost of removing those for which they may be responsible. Their attitude in this regard could be determined before submitting the final report to Congress in regard to cooperation.

TERMINAL FACILITIES, ETC.

79. The situation as regards terminals is favorable. Possible location for terminal warehouses and landings are—

(*a*) Left bank from the viaduct to the mouth.

(*b*) Right bank in vicinity of Central Avenue and above the stockyards front for unloading live stock.

(*c*) Right bank above Turkey Creek. The passenger switching yards are now bein located in this vicinity.

(*d*) Left bank above the site of the old Argentine wagon bridge. This is of eas access from two large soap factories.

80. There are at present no wharves nor terminal facilities for public use, but ther is ample space for the construction of same.

The Stewart-Peck Sand Co. have docks, bins, and loading cranes for the handlin of sand. These are not for public use.

81. The railroads have easy access to this river, several of them being riparia owners. There does not appear to be any mutual contract for prorating and interchanging traffic between the railroads and the water carriers.

82. The development of water power is not involved in this improvement.

83. The question of flood protection is closely involved in this project, and it discussion has already been covered in this and former reports.

84. Very little land would be reclaimed by this project.

COMMERCE.

85. An improved channel would be for the purpose of enabling the factories an plants near the Kansas River to load their shipments on small barges in the Kansa River, these barges to be towed by gasoline boats to the municipal dock on the Missouri River, where the shipment would be transferred to the Missouri River barge The saving in freight charges would result for some firms in eliminating the switchin charges from factory to municipal dock, and for other firms in enabling them to shi or receive by water certain materials that the boat line can not now deliver.

86. The present water rates between Kansas City and St. Louis are 80 per cent c existing railroad rates. Practically all of the plants and factories in the section c the Kansas River valley known as the West Bottoms have excellent switching facilities and can load the cars in their own yards. The present switching charges in Kansas City, Mo., and Kansas City, Kans., are from $3 to $5 a car over a single line. A 20 cents per ton-mile a car load of 30 tons could be hauled by truck a distance of on mile for $6. So it is seen that the factories more than one mile distant from the Kansa River could not very economically avail themselves of the proposed improvement.

87. The commerce originating in the West Bottoms is enormous, but the amoun that would be diverted to the Kansas River is limited to a portion of the products c a very few firms. A recent personal investigation of conditions and conversatior with several of the interested parties have shown that, with the exception of abou five or six firms, the community is entirely indifferent to the proposed improvemer except in so far as it bears on the question of flood control. These five or six firm are interested in the proposed improvement, and it is believed that they would b materially benefited by a saving in freight rates and possibly by a resulting increas in volume of business.

88. The existing commerce economically available for water transportation contingent upon an adequate improvement is estimated as follows:

	Ton mile
Sand	540,00
Soap (downstream)	10,00
Caustic soda (upstream)	20,00
Crude glycerine (upstream)	3,50
Scrap iron, metal, and junk (downstream)	15,00
Boiler plate (upstream)	50
Boilers, tanks, etc. (upstream)	50
Total (local delivery)	589,50

89. The saving in freight rates on the above products is estimated as follows:

Soaps, caustic soda, and glycerine, 6.700 tons, or about 300 cars at $4 a car, net saving in switching charges	$1,20
Scrap iron, 15,000 tons. Improvement makes water shipment possible. Saving 20 per cent on freight rates to St. Louis, less 5 per cent for handling—15 per cent × $2 × 15,000	4,50
Boiler plate, water transportation made available. Estimated saving on 1,000 tons	50
Boilers and tanks. Local delivery to packing houses, etc. Estimated saving	10
Total	6.3

90. In addition to the above, there would probably be some traffic in packing-
use products that do not require refrigeration and in live stock upstream from
ne of the Missouri River towns. With the establishment of through water ship-
ents between Kansas City and New Orleans, the Kansas River commerce would
bably be increased by shipments upstream of coconut oil and rosin for the soap
tories and by downstream traffic of grain and hay.

PROJECTS.

1. Three plans for improving the navigable channel of the Kansas River are sub-
tted, as follows:

2. *Project A.*—Removal of all obstructions within the harbor lines or levee lines.
is involves no dredging and allows for a natural channel of from 2½ to 3 feet in
th. The removal of the obstructions should be at the expense of the owners
ere determined, and where the owners are unknown the United States and the
w Valley Drainage Board should share equally the expense of removal. The
imate of the cost of the removal is based on the average of the costs given for the
oval of the Union Pacific and the stock yards bridges. Lump-sum estimates
ed on these figures will give a reasonable approximation, but for an estimate of
cost of each individual obstruction a more extended investigation would be
uired. The estimated cost is as follows:

e United States	$4,000
e Kaw Valley Drainage Board	4,000
e bridge owners	60,000
Total for project A	68,000

3. *Project B.*—The removal of all obstructions and the dredging of a channel of
imum depth of 4 feet at mean low water with channel 150 feet wide up to the
t Line Bridge and 100 feet wide from there up, the bridge owners to pay the cost
emoving the obstructions where the ownership can be established, the United
tes and the Drainage Board for those where the ownership can not be established.
he estimate of this project is as follows:

the United States:	
106,900 cubic yards of excavation, at 15 cents	$16,035
Superintendence, office expense, inspection, etc	4,965
Removal of obstructions	4,000
Total	25,000
the Kaw Valley Drainage Board, removal of obstructions where the owner-ip is not determined	4,000
bridge owners, removal of obstructions	60,000
Total for project B	89,000

. For maintenance it is estimated that about 100,000 yards per annum will have
e dredged and this can be accomplished by operating a suction dredge, a small
line towboat, and scows for 4 months in the year, at $1,500 per month. Adding
00 for office expenses, contingencies, etc., the estimate reaches $7,500 per annum
aintenance.

. *Project C.*—This project calls for the removal of all obstructions and for dredg-
a channel 150 feet wide from near the mouth to the Belt Line Bridge, and 100
wide from there to the West Kansas Avenue Bridge, with a minimum depth of
et at mean low water. The estimate of this project is as follows:

to the United States:	
Removing obstructions and snagging	$4,000
Dredging, 341,139 cubic yards, at 15 cents	51,170
Superintendence, office expenses, etc	5,000
Total to United States	60,170
to Kaw Valley Drainage Board, removal of obstructions	4,000
to bridge owners, removal of obstructions	60,000
Total for project C	124,170

e same plant as for project B could maintain the channel by increasing the time
eration. The estimate for maintenance of project C is therefore placed at $10,000
ear.

MOUTH OF RIVER.

96. To direct the flow of the Kansas and Missouri Rivers at their junction so tha the two currents will meet obliquely it is proposed to construct two 3-row pil dikes at I and K as shown on blue print Q 375/1. The dike at I is necessary to deflec the Kansas River and the dike at K serves the purpose of protecting dike I from th attack of the Missouri River and also serves to deflect the Missouri River. It i believed that this construction will greatly improve conditions at the mouth and wil in a large measure prevent the formation of a bar across the mouth of the Kansa River. As this structure will have a tendency to keep the mouth of the river clea and thereby greatly facilitate the flood discharge, it may be well for the Kaw Valle Drainage Board to cooperate in this feature of the improvement. The protectio offered to the riparian owners is of too limited extent to reasonably expect cooperatio from them. The estimated cost of this work is as follows:

Dike I. 420 linear feet of 3-row wooden pile dike at $15 per linear foot	$6, 3
Dike K. 300 linear feet of 3-row wooden pile dike at $15 per linear foot	4, 5
Total	10, 8
Contingencies	1, 2
	12, 0

The cost should be distributed as follows:

To the United States	6, 0
To the Kaw Valley Drainage Board	6, 0
Total	12, 0

COOPERATION.

97. The plans for flood protection under which the Kaw Valley Drainage Boa are working are explained at length in the former report of Maj. Edward H. Schu (H. Doc. 94, 62d Cong., 2d sess.) These plans are well under way. The levee c struction is nearing completion and there are now under discussion the best meth for closing the gap on the right bank at Turkey Creek and the left bank at the blu above the James Street Bridge. It is understood that the drainage board desi the removal of all earth within the levee lines down to standard low water and all so obstructions down to the scour line. It also seems to be the desire to have the Fede Government take charge of and execute the necessary work of removing the obstr tions. Provided an equitable basis of cooperation be agreed upon, this seems to b proper and satisfactory arrangement.

98. The following estimates are submitted as a tentative basis for opening nego tions as to cooperation:

(*a*) Removal of all earth within the levees and down to standard low water, 2,851,100 cubic yards, at 20 cents (charge to Kaw Valley Drainage Board)	$570,
(*a*¹) Or, if desired by the Kaw Valley Drainage Board, the total prism within the levees and down to scour line can be excavated according to estimate as follows: 10,290,235 cubic yards, at 20 cents (charge to the Kaw Valley Drainage Board)	2, 058,
This large expenditure does not appear advisable.	
(*b*) Removal of all obstructions down to scour line, the expense to be borne as follows:	
By the United States	4,
By the Kaw Valley Drainage Board	4,
By the bridge owners and other responsible parties	60,
Total	68,
(*c*) The excavation of a 4-foot channel, 106,900 cubic yards, at 15 cents (cost borne by the United States)	16
(*c*¹) Or, the excavation of a 6-foot channel, 341,139 cubic yards, at 15 cents (cost borne by the United States)	51
(*d*) Dikes at the mouth, 720 feet 3-row pile dike	12
By the United States $6, 000	
By the Kaw Valley Drainage Board 6, 000	

CONCLUSIONS AND RECOMMENDATIONS.

99. After due consideration of all phases of the question, the following conclusions nd recommendations are submitted:

(*a*) The removal of all obstructions affecting navigation should be required by the nited States under Federal statutes.

(*b*) The removal of all obstructions not affecting navigation but affecting flood ischarge could be undertaken by the drainage board under the State laws.

(*c*) The 4-foot channel is adequate for the present needs of commerce, but the amount commerce does not at present justify the expenditure.

(*d*) The 6-foot channel is not at present necessary but could readily be obtained hould future needs of commerce demand it.

(*e*) Construction of the dikes at the mouth is advisable.

(*f*) For maintenance of a channel some dredging will probably be necessary.

The following project is suggested, the work to be done and the cost borne as indi- ated:

emoval of earth down to standard low water (by Kaw Valley Drainage Board)	$630,000
nstruction of dikes at the mouth (by the United States)	12,000
emoval of all obstructions down to scour line (by the United States and bridge owners)	68,000
Total	710,000

The expense of this work to be distributed as follows:

he United States:		
Removal of obstructions	$4,000	
One-half cost of constructing dikes	6,000	
		10,000
he Kaw Valley Drainage Board:		
Earth excavation	630,000	
Removal of obstructions	4,000	
One-half cost of constructing dikes	6,000	
		640,000
he parties responsible for obstructions, débris, wreckage, etc.		60,000
Total		710,000

100. The work would be prosecuted by clearing the obstructions in the channel by ired labor, the plant to consist of a "power boat," or a barge equipped with a derrick, oisting engine, and possibly a bucket dredge. The removal of earth above standard w water would be undertaken by the drainage board. The construction of the dikes n be done by contract and would possibly be completed in one season. It is impos- ble, however, to estimate the time required for the complete removal of obstructions.

Robert S. Thomas.

Appendix B.

Table III.—*Gage readings, Kansas River, January to June, 1913.*

[Made under direction of Maj. Herbert Deakyne, Corps of Engineers, United States Army.]

MISSOURI RIVER—HANNIBAL BRIDGE, 1913.

Days.	January.		February.		March.		April.		May.		June.	
	a. m.	p. m.	a. m.	p. m.	a. m.	p. m.	a. m.	p. m.	a. m.	p. m.	a. m.	p. m.
1	....	....	309.2	309.1	308.8	308.6	313.2	314.4	315.5	315.3	316.0	316.
2	....	....	308.8	307.2	308.5	308.1	314.3	314.0	315.2	314.9	315.9	315.
3	....	....	309.2	309.0	308.1	308.2	314.3	314.7	314.9	314.8	315.5	315.
4	....	....	309.1	308.9	308.3	309.2	314.2	314.7	315.4	315.9	315.3	315.
5	308.7	308.8	309.2	309.4	313.1	310.7	315.7	315.0	316.7	317.1	314.9	314.
6	307.4	306.8	309.5	309.7	310.0	309.9	315.8	315.2	317.8	318.0	315.2	315.
7	306 0	305.5	309.9	311.0	309.9	310.1	314.4	314.2	317.9	318.0	315.4	315.
8	305.5	305.4	312.8	312.9	310.4	310.5	314.2	314.5	317 8	317.6	315.6	317.
9	305.1	305.6	313.2	313.3	311.9	311.4	314.8	314.9	317.2	316.8	318.9	320.
10	305.4	305.2	313.5	313.2	310.9	310.1	316.2	317.2	316.3	316.0	319.8	319.
11	305.1	305.3	313.1	312.9	310.4	311.3	318.6	319.4	315.9	316.0	319.8	319.
12	305.7	306.4	312.4	312.0	312.9	312.7	320.4	321.2	316.5	316.4	319.6	319.
13	306.9	306.9	311.7	311.3	312.7	313.3	322.1	322.9	316.1	315.9	319.4	319.
14	307.2	307.4	311.5	311.5	313.2	313.2	323.5	324.0	316.6	317.0	319.3	319.
15	306.6	306.4	311.5	312.4	313.4	316.8	324.6	325.0	316.7	316.6	319.2	319.
16	306.2	306.3	310.7	310.5	316.0	316.0	325.3	325.5	316.6	317.1	319.2	319.
17	306.8	308.3	309.6	309.4	315.0	314.7	324.8	323.1	317.7	318.3	319.2	319.
18	308.5	308.4	309.5	310.4	314.3	314.0	321.5	320.8	318.2	317.8	319.4	319.
19	308.4	308.3	309.9	309.4	313.4	313.0	320.0	319.8	317.2	316.9	319.2	319.
20	308.5	308.4	309.6	310.2	312.1	311.9	319.2	318.8	316.7	316.3	319.0	318.
21	307.9	307.5	310.1	309.8	311.6	311.5	318.4	318.1	316.3	316.8	318.9	318.
22	307.6	307.9	309.6	309.5	311.4	311.5	317.8	317.2	317.2	317.9	319.0	319.
23	308.2	308.3	309.5	309.7	311.1	310.9	316.9	316.7	317.9	317.8	319.1	319.
24	308.8	308.8	309.5	309.5	310.6	310.4	316.3	316.3	318.2	318.1	319.0	319.
25	309.0	309.2	309.4	309.6	310.4	310.5	316.4	316.4	317.9	317.4	319.6	320.
26	309.5	309.5	309.9	310.0	310.4	311.0	316.6	316.4	316.9	317.1	320.1	319.
27	309.9	310.2	309.8	310.1	311.5	311.6	316.4	316.3	317.4	317.5	319.7	319.
28	310.2	309.8	309.1	309.2	312.2	312.9	316.2	316.2	317.5	317.4	319.0	318.
29	309.5	309.3	....	....	312.7	312.2	316.1	315.9	317.2	317.0	....	....
30	309.3	309.4	....	....	311.2	310.9	315.8	315.6	316.6	316.3	....	....
31	309.4	309.6	....	....	310.6	310.5	....	....	316.1	316.0	....	....

KANSAS RIVER—GREAT WESTERN BRIDGE, 1913.

Day.	January.		February.	
	a. m.	p. m.	a. m.	p. m.
1	....	....	309.1	309.1
2	....	....	....	....
3	....	....	....	....
4	....	....	....	....
5	....	....	....	....
6	....	....	....	....
7	....	....	....	....
8	....	....	....	....
9	....	....	....	....
10	....	....	....	....
11	....	....	....	....
12	....	....	....	....
13	....	....	....	....
14	....	....	....	....
15	....	....	....	....
16	....	....	....	....
17	....	....	....	....
18	....	....	....	....
19	308.9	309.2	....	....
20	309.0	308.9	....	....
21	308.4	308.4	....	....
22	308.3	308.5	....	....
23	309.0	309.8	....	....
24	309.3	309.6	....	....
25	309.8	309.9	....	....
26	310.1	309.9	....	....
27	309.7	311.4	....	....
28	310.9	310.2	....	....
29	310.3	310.0	....	....
30	310.2	310.1	....	....
31	310.1	310.1	....	....

TABLE III.—*Gage readings, Kansas River, January to June, 1913*—Continued.

KANSAS RIVER—JAMES STREET BRIDGE, 1913.

Day.	February.		March.		April.		May.		June.	
	a. m.	p. m.	a. m.	p. m.	a. m.	p. m.	a. m.	p. m.	a. m.	p. m.
	....	....	310.5	310.1	314.9	315.8	316.1	315.9	316.9	316.9
	....	....	309.7	309.2	315.4	315.2	315.9	315.6	316.7	316.6
	....	....	309.7	310.0	315.7	316.2	315.6	315.6	316.3	316.4
	....	....	309.9	309.6	315.5	316.2	316.4	316.9	316.1	316.0
	....	....	313.6	311.4	317.5	317.6	317.8	318.5	315.8	315.9
	....	....	310.5	310.8	317.0	316.5	319.2	319.3	316.0	316.1
	....	....	310.6	311.2	315.7	315.5	319.3	319.4	316.2	316.5
	....	....	311.5	311.7	315.4	315.9	319.1	318.9	317.1	319.3
	....	....	313.2	312.9	316.1	316.3	318.5	317.9	320.8	321.3
	....	....	312.0	311.9	318.0	319.0	317.4	317.0	321.6	321.8
	....	....	311.7	312.9	320.7	321.5	316.9	317.3	321.5	321.4
	....	....	314.3	314.0	322.4	323.1	317.8	317.8	321.2	321.1
	....	....	315.3	314.8	324.3	325.2	317.2	317.1	321.0	321.0
	....	....	314.5	314.3	325.8	326.4	318.3	318.5	320.7	320.6
	....	313.3	314.9	316.4	326.8	327.3	318.1	318.0	320.6	320.5
	311.2	311.1	317.4	317.2	327.6	327.7	317.9	318.6	320.5	320.4
	310.2	310.1	316.5	315.8	326.6	324.5	319.4	319.9	320.4	320.6
	310.2	311.3	315.3	315.1	322.6	322.1	319.8	319.0	320.7	320.5
	310.4	309.9	314.5	313.8	321.3	320.9	318.0	318.0	320.4	320.4
	310.4	310.9	312.9	312.7	320.0	319.8	317.7	317.3	320.1	320.0
	310.4	310.4	312.3	312.1	319.2	319.0	317.5	317.9	320.0	320.2
	309.8	309.9	312.1	312.1	318.3	318.0	318.5	319.3	320.2	320.4
	309.7	308.8	311.8	310.4	317.5	317.3	319 4	319.2	320.3	320.4
	310.5	309.8	311.2	311 2	316.9	316.9	319.7	319.7	320.4	320 4
	310 0	310.1	311.0	310.9	317.0	317.2	319.3	318.6	321.1	321.4
	310.9	310.5	311.0	311.7	317.2	317.2	318.1	318.4	321.6	321.5
	310.3	310.7	312.1	312.3	317.1	317.1	318.5	318.6	321.2	320.8
	311.2	311.3	312.7	314.2	316.9	317.0	318.7	318.5	320.3	320.1
	....	....	313.6	313.1	316.8	316.6	318.2	317.9	....	....
	....	....	311.9	311.7	316.4	316.3	317.4	317.2	....	....
	....	....	311.3	311.3	....	....	316.9	317.0	....	....

KANSAS RIVER—CENTRAL AVENUE BRIDGE, 1913.

ay.	January.		February.		March.		Day.	January.		February.		March.	
	a. m.	p. m.	a. m.	p. m.	a. m.	p. m.		a. m.	p. m.	a. m.	p. m.	a. m.	p. m.
	....	....	309.6	309.6	310.4	310.1	17....	308.8	309.2	310.3	310.3	316.4	315.9
	....	....	309.0	307.9	309.1	308.9	18....	309.3	309.2	310.2	311.3	315.5	315.1
	....	....	309.1	309.3	309.7	310.0	19....	309.3	309.3	310.5	310.1	314.5	314.0
	....	....	309.3	309.3	310.0	310.1	20....	309.3	309.2	310.2	310.8	313.0	312.7
	....	....	309.6	309.6	314.3	312.4	21....	308.3	308.3	310.8	310.6	312.3	312.2
	....	....	310.0	310.0	311.8	311.7	22....	308.1	308.5	310.0	310.1	312.1	312.1
	....	....	310.3	311.1	310.8	311.3	23....	309.1	309.2	309.9	310.0	311.8	311.4
	....	....	313.7	313.8	311.7	311.7	24....	309.4	309.6	310.0	310.3	311.2	311.3
	....	....	314.9	314.5	313.2	313.1	25....	309.8	310.0	310.2	310.3	311.2	311.2
	....	....	314.5	314.5	312.1	312.1	26....	310.3	310.3	310.3	310.8	311.2	311.4
	....	....	313.9	313.8	....	....	27....	310.5	310.8	310.4	310.8	312.1	312.3
	307.6	308.1	313.0	312.8	314.2	314.0	28....	310.9	310.5	311.1	311.1	312.5	313.9
	308.2	308.3	312.2	311.9	314.2	314.7	29....	310.2	310.1	....	....	313.7	313.0
	308.4	308.5	312.1	312.0	314.5	314.3	30....	310.1	310.0	....	....	312.0	311.6
	308.3	308.4	312.0	312.3	314.8	315.7	31....	310.0	310.0	....	....	311.4	311.3
	308.6	308.7	311.1	311.4	317.4	317.3							

TABLE III.—*Gage readings, Kansas River, January to June, 1913*—Continued.

KANSAS RIVER—TWELFTH STREET BRIDGE, 1913.

	January.		February.		March.		April.		May.		June.	
	a. m.	p. m.	a. m.	p. m.	a. m.	p. m.	a. m.	p. m.	a. m.	p. m.	a. m.	p. m.
1	....	....	310.7	310.7	310.7	310.3	314.7	315.8	316.0	315.8	317.0	317.
2	....	....	310.6	309.9	310.6	310.2	315.5	315.5	315.7	315.6	316.9	316.
3	....	....	310.1	310.0	310.7	310.7	315.4	316.0	315.6	315.5	316.5	316.
4	....	....	310.1	309.9	310.7	310.8	315.6	316.3	316.2	316.9	316.3	316.
5	....	....	310.3	309.7	314.9	313.4	317.4	317.5	317.7	318.6	315.8	316.
6	....	....	310.5	310.1	312.7	312.4	317.2	316.6	319.1	319.7	316.1	316.
7	....	....	310.5	311.4	312.1	313.0	316.0	315.5	319.9	320.6	316.3	316.
8	....	....	313.4	314.0	313.3	313.0	315.4	316.3	320.4	320.0	316.7	319.
9	....	....	314.6	314.2	313.6	313.5	316.3	316.6	319.3	318.7	320.8	321.
10	....	....	314.3	314.2	313.0	312.9	318.4	319.5	317.8	317.5	321.6	321.
11	....	....	313.8	313.5	313.2	313.3	320.7	321.5	317.4	....	321.6	321.
12	....	....	313.1	312.7	314.5	314.2	322.4	323.1	....	319.6	321.3	321.
13	....	....	312.3	312.1	314.3	314.8	324.3	325.2	318.7	319.0	321.1	321.
14	....	....	312.1	312.1	314.6	314.5	325.7	326.0	321.3	321.9	321.0	320.
15	....	....	312.2	312.4	315.1	316.5	326.7	327.4	320.8	320.3	320.7	320.
16	311.1	310.9	311.6	311.4	317.4	317.3	327.2	327.0	319.7	320.1	320.5	320.
17	310.8	310.9	311.1	311.5	316.6	315.9	326.6	324.6	320.3	320.8	320.4	320.
18	310.7	310.8	311.5	311.9	315.6	315.2	322.8	320.8	320.3	319.5	320.6	320.
19	310.7	310.6	311.5	311.3	314.7	314.3	321.2	320.6	318.7	318.4	320.5	320.
20	310.6	310.5	310.9	311.5	313.5	313.1	320.0	319.5	318.4	318.0	320.2	320.
21	310.2	309.9	310.8	310.8	313.1	312.9	319.2	318.6	318.0	318.4	320.1	320.
22	309.9	310.1	310.6	310.7	312.8	312.8	318.1	317.9	318.9	320.3	320.3	320.
23	310.1	310.6	310.8	311.0	312.7	312.4	317.4	317.2	320.1	320.5	320.3	320.
24	310.5	311.0	311.1	311.1	312.5	312.8	316.7	316.9	321.8	322.1	320.1	320.
25	311.0	311.1	310.8	310.9	313.0	313.0	316.8	317.1	321.4	320.4	321.1	321.
26	311.2	311.4	310.9	311.1	312.8	312.9	317.0	317.2	319.4	319.1	321.7	321.
27	311.4	311.7	311.0	311.1	313.0	313.0	317.0	317.1	318.9	319.1	321.3	320.
28	311.6	311.6	311.3	311.1	313.1	314.1	316.8	316.9	319.0	318.8	320.3	320.
29	310.6	310.6	....	....	314.0	313.3	316.7	316.6	318.5	318.1	....	....
30	310.5	310.9	....	....	312.7	312.6	316.5	316.2	317.8	317.5	....	....
31	310.9	310.9	....	....	312.5	312.5	....	....	317.1	317.1	....	....

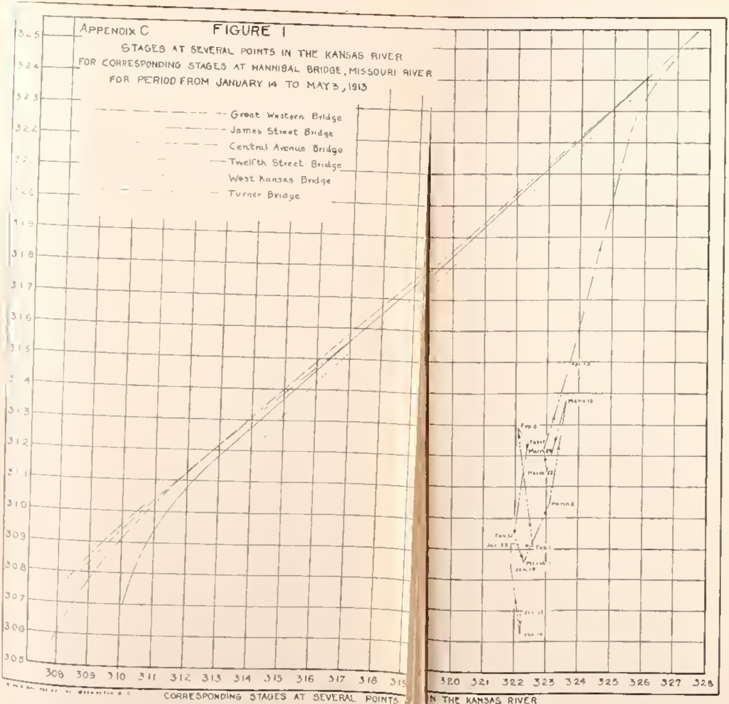
KANSAS RIVER—WEST KANSAS AVENUE BRIDGE, 1913.

Day.	March.		April.		May.		June.	
	a. m.	p. m.	a. m.	p. m.	a. m.	p. m.	a. m.	p. n
1	....	....	314.3	314.5	316.2	316.1	317.5	31
2	....	....	315.5	315.2	315.9	315.8	317.4	31
3	....	....	315.7	316.3	315.8	315.8	317.0	31
4	....	....	316.3	316.7	316.7	317.1	316.8	31
5	....	....	317.2	317.6	317.7	318.9	316.4	31
6	....	....	317.2	316.0	319.5	320.0	316.6	31
7	....	....	315.6	316.0	320.5	321.4	316.8	31
8	....	....	316.1	317.0	321.3	321.0	317.2	31
9	....	....	317.0	317.1	320.8	319.4	319.7	32
10	....	....	319.9	320.0	318.7	318.2	322.0	32
11	....	....	321.0	321.6	318 0	319.8	321.9	32
12	....	....	322.0	322.7	320.9	320 7	321.6	32
13	....	....	323.7	323.8	319.8	320.0	321.2	32
14	....	....	324.6	325.3	322.7	323.5	321.1	32
15	....	....	325.7	326.1	322.4	321.8	321.0	3
16	....	....	326.6	327.5	320.9	321.2	320.7	3
17	....	....	325.4	324.8	321.2	321.5	320.6	3
18	....	....	323.5	322.2	321.0	320.2	320.9	3
19	....	....	322.0	321.7	319.2	319.0	320.8	3
20	....	....	320.7	320.0	319.1	318.8	320.5	3
21	....	....	319.6	319.0	318.8	319.0	320.4	3
22	....	....	318.	318.1	319.6	321.1	320.5	3
23	....	....	317.6	317.2	321.0	321.4	320.8	3
24	....	313.7	317.1	317.1	323.1	323.5	320.8	3
25	313.7	314.2	317.2	317.3	322.3	321.6	320.6	3
26	313.3	313.7	317.4	317.5	320.5	320.0	322.0	3
27	313.0	312.9	317.4	317.3	319.8	319.6	321.6	3
28	313.8	314.5	317.1	316.7	319.8	319.4	320.7	3
29	314.3	314.0	316.6	316.6	319.1	318.7	....	...
30	313.5	313.5	316.5	316.4	318.4	318.0	....	...
31	313.6	313.5	....	....	317.7	317.6	....	...

TABLE III.—*Gage readings, Kansas River, January to June, 1913*—Continued.

KANSAS RIVER—TURNER BRIDGE, 1913.

Day.	January.		February.		March.		April.		May.		June.	
	a. m.	p. m.	a. m.	p. m.	a. m.	p. m.	a. m.	p. m.	a. m.	p. m.	a. m.	p. m.
1	....	....	321.8	322.6	322.3	322.3	322.9	322.9	322.7	322.7	323.7	323.6
2	....	....	322.2	322.2	322.3	322.3	322.8	322.8	322.7	322.7	323.5	323.5
3	....	....	322.4	322.4	322.3	322.5	322.7	322.7	322.6	322.5	323.3	323.3
4	....	....	322.2	322.2	322.5	322.3	323.1	323.6	322.6	322.7	323.2	323.2
5	....	....	322.2	322.0	322.3	322.4	323.8	323.7	322.9	323.1	323.1	323.3
6	....	....	322.1	322.1	322.3	322.3	324.0	324.3	324.1	325.5	323.3	323.2
7	....	....	322.1	322.0	322.8	323.3	323.9	323.6	327.2	328.0	323.1	323.3
8	....	....	322.1	322.1	323.4	323.1	324.0	324.6	327.0	327.4	323.4	323.6
9	....	....	322.1	322.3	322.9	322.9	324.3	324.7	326.5	325.8	324.3	324.2
10	....	....	322.2	322.2	323.0	323.0	326.6	326.5	325.3	324.9	323.7	323.5
11	....	....	322.2	322.2	323.1	323.1	325.7	325.6	325.0	327.4	323.4	323.6
12	....	....	322.1	322.3	323.1	323.0	325.5	325.2	328.1	327.9	323.9	323.7
13	322.2	322.2	322.1	322.2	323.0	323.1	325.2	325.5	326.1	327.7	323.6	323.5
14	322.2	322.2	322.0	322.2	323.2	323.3	325.9	326.7	330.5	330.6	323.4	323.3
15	322.2	322.2	322.1	322.4	323.7	323.6	327.0	327.3	329.3	328.7	323.3	323.3
16	322.2	322.2	322.2	322.0	323.8	323.9	327.6	327.8	327.7	327.7	323.2	323.2
17	321.9	321.9	322.0	322.3	323.8	323.6	326.7	325.9	327.2	327.2	323.2	323.1
18	321.9	321.9	322.2	322.2	323.4	323.3	323.4	323.3	326.3	325.7	323.0	323.0
19	321.7	321.7	322.1	322.1	323.2	323.1	323.2	323.1	325.5	325.3	322.9	322.9
20	321.8	321.7	322.0	322.0	323.1	323.1	323.0	323.0	325.6	325.4	322.8	322.7
21	321.5	321.5	322.1	322.1	323.1	323.0	323.0	323.0	325.2	325.2	322.6	322.6
22	321.5	321.3	322.0	322.0	322.9	323.0	322.8	322.8	325.7	327.2	322.5	322.5
23	321.3	321.6	321.9	322.0	323.0	322.9	322.8	322.7	327.0	327.9	322.4	322.5
24	321.4	321.9	321.8	321.8	323.1	323.4	322.6	322.7	329.9	330.1	322.5	322.5
25	321.8	321.9	321.8	321.8	323.6	323.5	322.7	322.7	329.1	328.2	324.6	324.6
26	321.9	321.9	321.8	321.7	323.3	323.3	322.7	322.7	327.1	326.2	324.1	323.8
27	321.9	321.9	321.6	322.0	323.2	323.2	322.7	322.7	325.6	325.4	323.2	322.7
28	321.8	321.8	322.0	322.1	323.0	323.0	322.7	322.7	325.2	325.0	322.6	322.5
29	321.8	321.8	....	....	322.9	322.9	322.7	322.8	324.7	324.6	....	....
30	321.8	321.7	....	....	322.9	323.0	322.7	322.7	324.3	324.1	....	....
31	321.7	321.7	....	....	323.0	323.0	....	....	323.9	323.8	....	....



APPENDIX C

FIGURE I

STAGES AT SEVERAL POINTS IN THE KANSAS RIVER
FOR CORRESPONDING STAGES AT HANNIBAL BRIDGE, MISSOURI RIVER
FOR PERIOD FROM JANUARY 14 TO MAY 3, 1913

House Doc No 584; 63d Cong, 2d Sess

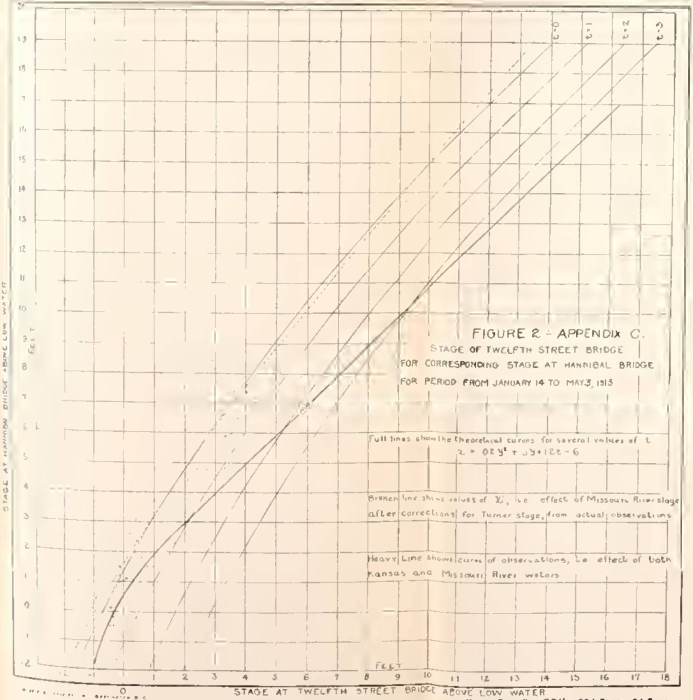


FIGURE 2 – APPENDIX C.

STAGE OF TWELFTH STREET BRIDGE FOR CORRESPONDING STAGE AT HANNIBAL BRIDGE FOR PERIOD FROM JANUARY 14 TO MAY 3, 1913

Full lines show the theoretical curves for several values of t

$x = .02y^2 + .5y + 1.2t - 6$

Broken line shows values of X', i.e. effect of Missouri River stage after corrections for Turner stage, from actual observations

Heavy Line shows curve of observations, i.e. effect of both Kansas and Missouri River waters

House Doc. No. *584*; 63d Cong., 2d Sess.

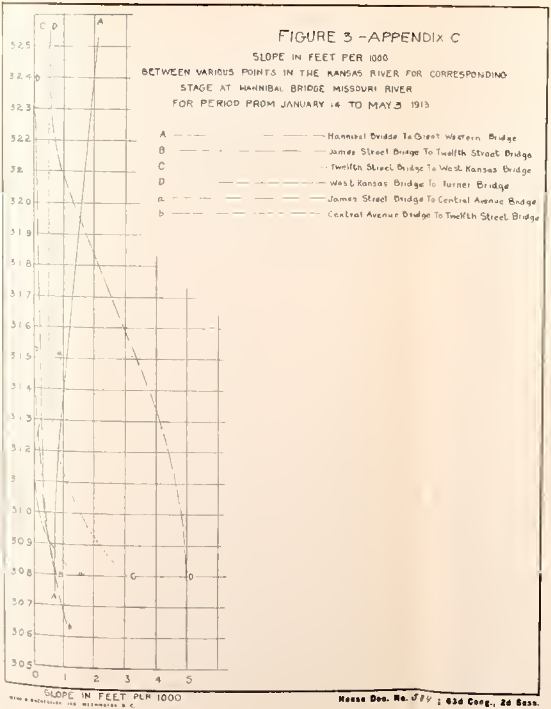


FIGURE 3 - APPENDIX C

SLOPE IN FEET PER 1000
BETWEEN VARIOUS POINTS IN THE KANSAS RIVER FOR CORRESPONDING
STAGE AT HANNIBAL BRIDGE MISSOURI RIVER
FOR PERIOD FROM JANUARY 14 TO MAY 3 1913

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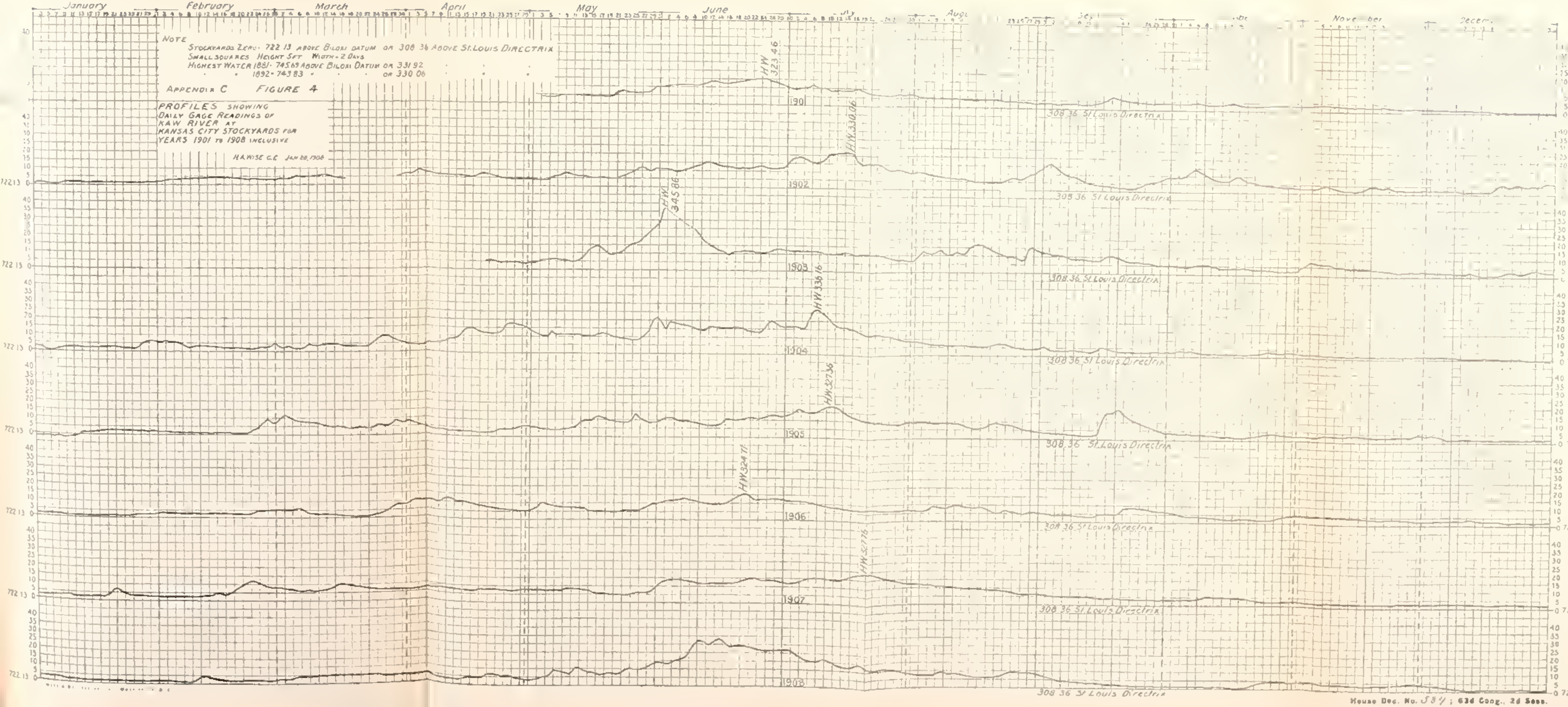
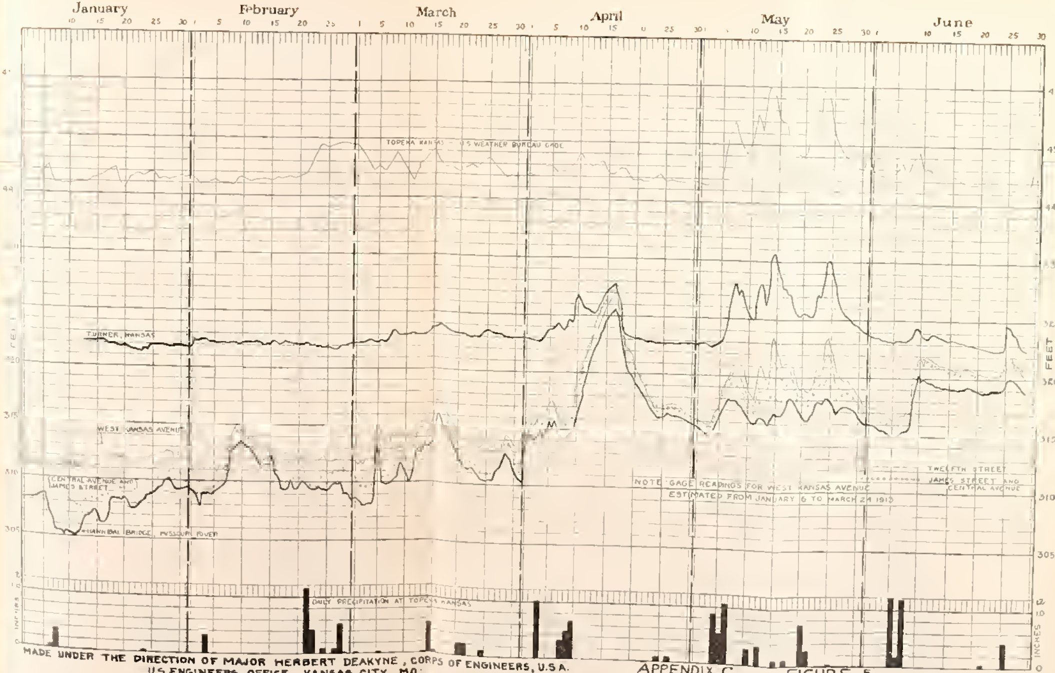


APPENDIX C FIGURE 4

PROFILES SHOWING
DAILY GAGE READINGS OF
KAW RIVER AT
KANSAS CITY STOCKYARDS FOR
YEARS 1901 TO 1908 INCLUSIVE

H. A. WISE C.E. JAN 28, 1908

NOTE
STOCKYARDS ZERO - 722.13 ABOVE BILOXI DATUM OR 308.36 ABOVE ST. LOUIS DIRECTRIX
SMALL SQUARES HEIGHT 5 FT WIDTH = 2 DAYS
HIGHEST WATER 1881 - 745.69 ABOVE BILOXI DATUM OR 331.92 " " "
" " 1892 = 743.83 " " " OR 330.06 " " "



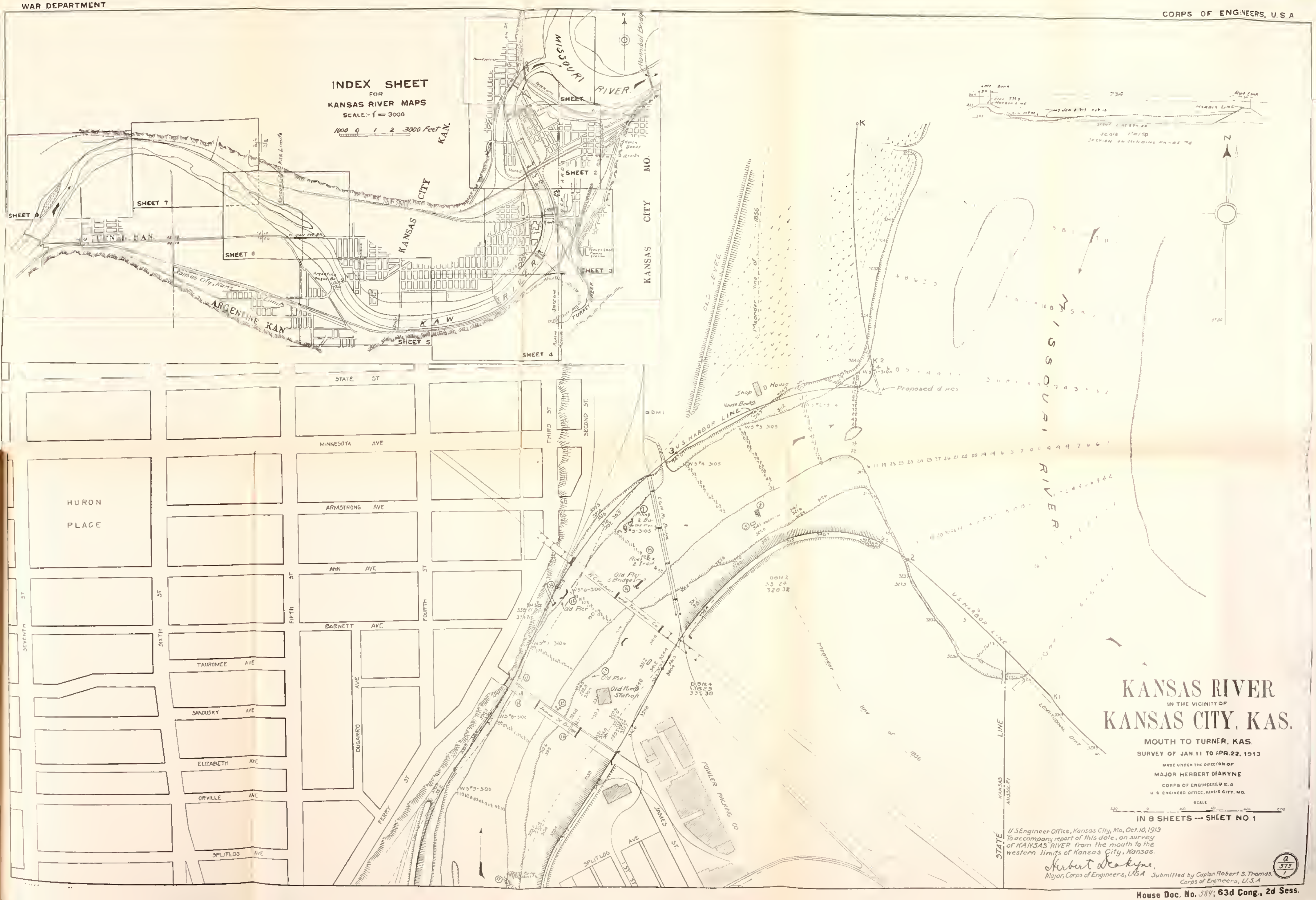
MADE UNDER THE DIRECTION OF MAJOR HERBERT DEAKYNE, CORPS OF ENGINEERS, U.S.A.
U.S. ENGINEERS OFFICE, KANSAS CITY, MO:
SUBMITTED BY CAPTAIN ROBERT S. THOMAS, CORPS OF ENGINEERS, U.S.A.

APPENDIX C. FIGURE 5
HYDROGRAPHS OF THE KANSAS RIVER, JANUARY TO JUNE 1913

House Doc. No 584 ; 63d Cong., 2d Sess.

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S.A



KANSAS RIVER

IN THE VICINITY OF

KANSAS CITY, KAS.

MOUTH TO TURNER, KAS.

SURVEY OF JAN. 11 TO APR. 22, 1913

MADE UNDER THE DIRECTION OF

MAJOR HERBERT DEAKYNE

CORPS OF ENGINEERS, U.S.A

U.S. ENGINEER OFFICE, KANSAS CITY, MO.

SCALE

IN 8 SHEETS --- SHEET NO. 1

U.S. Engineer Office, Kansas City, Mo., Oct. 10, 1913
To accompany report of this date, on survey
of KANSAS RIVER from the mouth to the
western limits of Kansas City, Kansas.

Herbert Deakyne.
Major, Corps of Engineers, U.S.A

Submitted by Captain Robert S. Thomas,
Corps of Engineers, U.S.A

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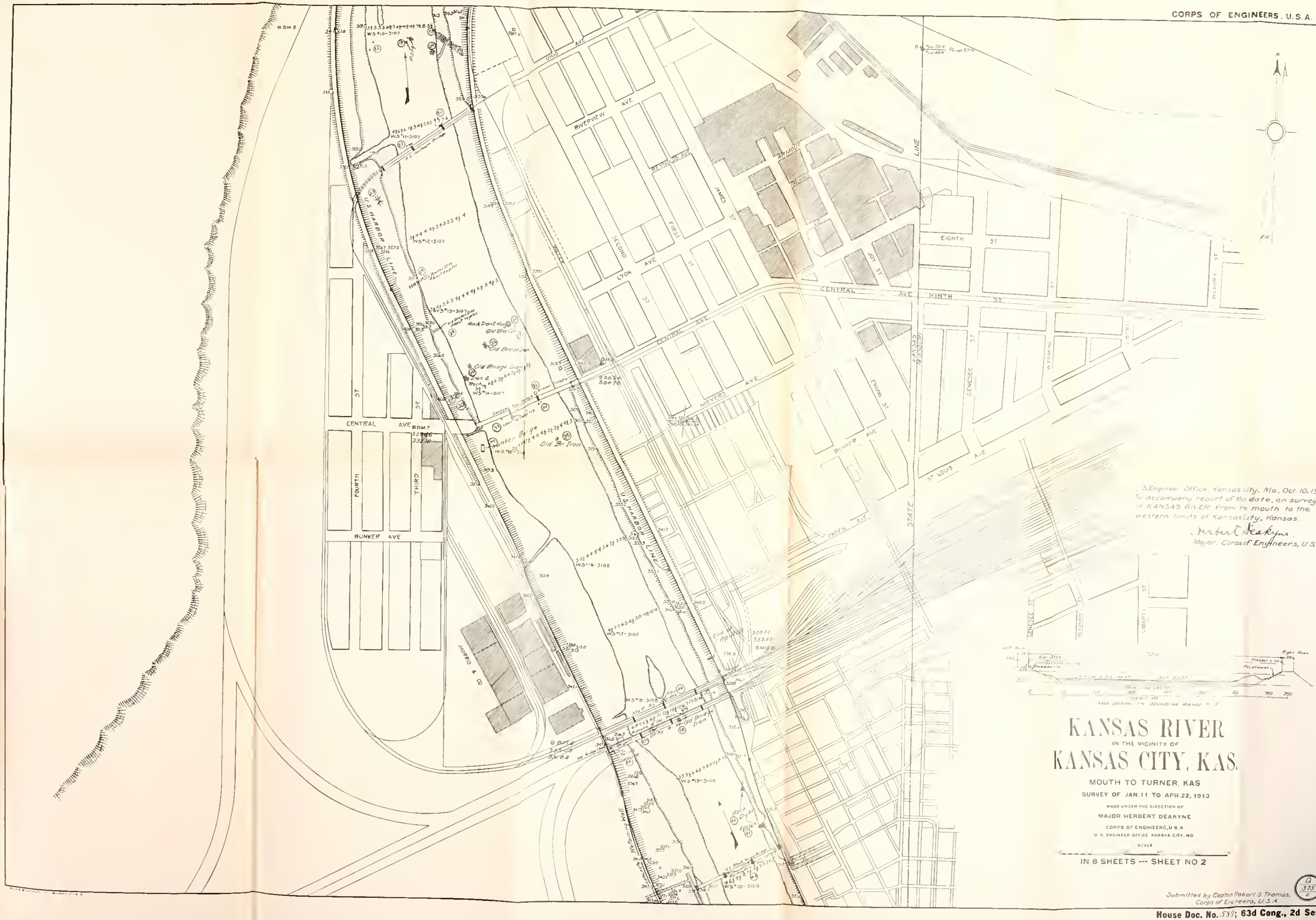
House Doc. No. 584; 63d Cong., 2d Sess.

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S.A.



U. S. Engineer Office, Kansas City, Mo., Oct. 10, 1913
To accompany report of this date, on survey of KANSAS RIVER from the mouth to the western limits of Kansas City, Kansas.

Herbert Deakyne
Major, Corps of Engineers, U.S.A.

KANSAS RIVER

IN THE VICINITY OF

KANSAS CITY, KAS.

MOUTH TO TURNER, KAS

SURVEY OF JAN.11 TO APR.22, 1913

MADE UNDER THE DIRECTION OF

MAJOR HERBERT DEAKYNE

CORPS OF ENGINEERS, U.S.A.

U.S. ENGINEER OFFICE KANSAS CITY, MO

SCALE

IN 8 SHEETS --- SHEET NO 2

Submitted by Captain Robert S. Thomas,
Corps of Engineers, U.S.A.

Q
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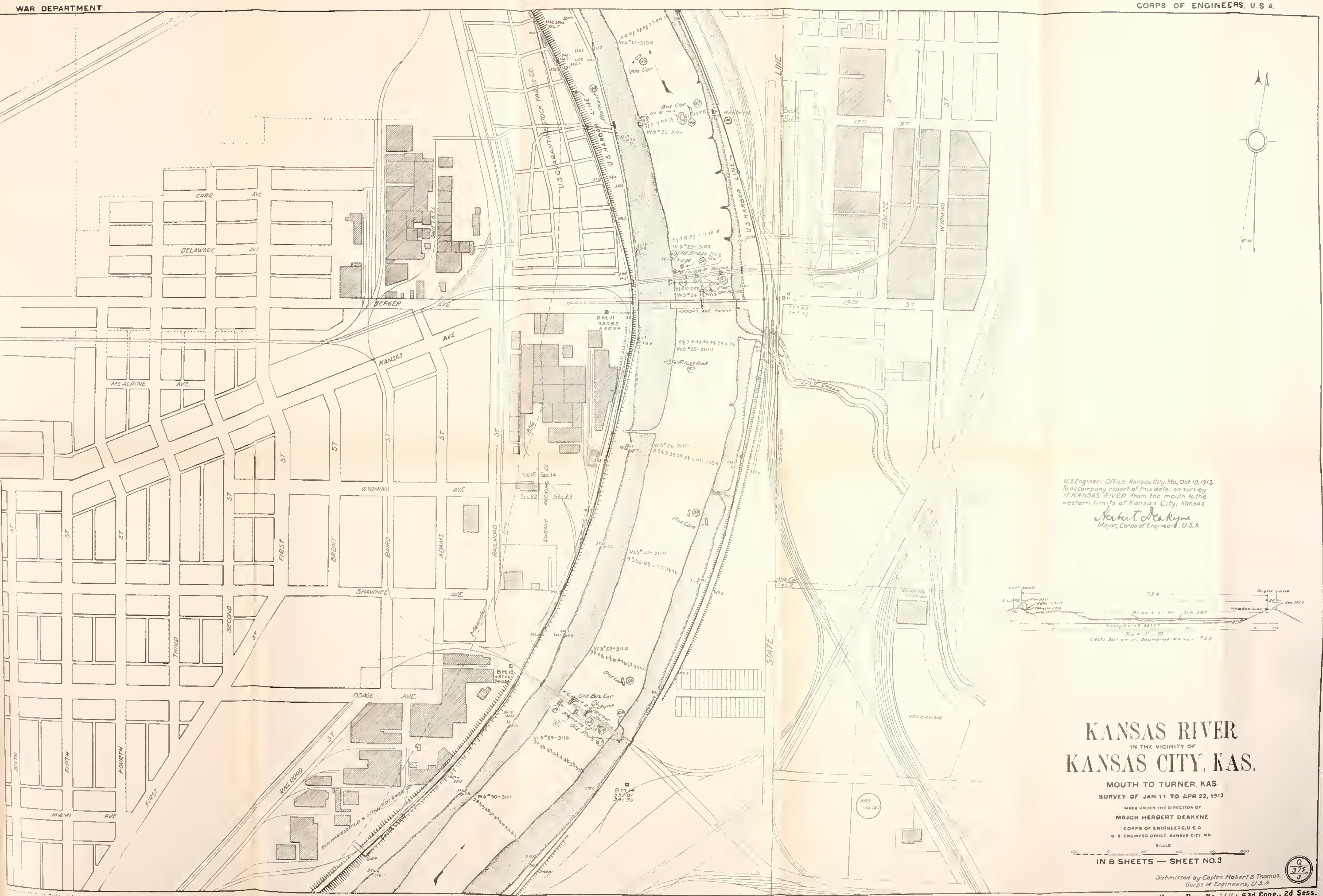
2

House Doc. No. 584; 63d Cong., 2d Sess.



U.S. Engineer Office, Kansas City, Mo. Oct. 10, 1913
To accompany report of this date, on survey
of KANSAS RIVER from the mouth to the
western limits of Kansas City, Kansas

Herbert Deakyne
Major, Corps of Engineers, U.S.A

KANSAS RIVER
IN THE VICINITY OF
KANSAS CITY, KAS.

MOUTH TO TURNER, KAS

SURVEY OF JAN 11 TO APR 22, 1913

MADE UNDER THE DIRECTION OF

MAJOR HERBERT DEAKYNE

CORPS OF ENGINEERS, U.S.A

U.S. ENGINEER OFFICE, KANSAS CITY, MO.

IN 8 SHEETS --- SHEET NO. 3

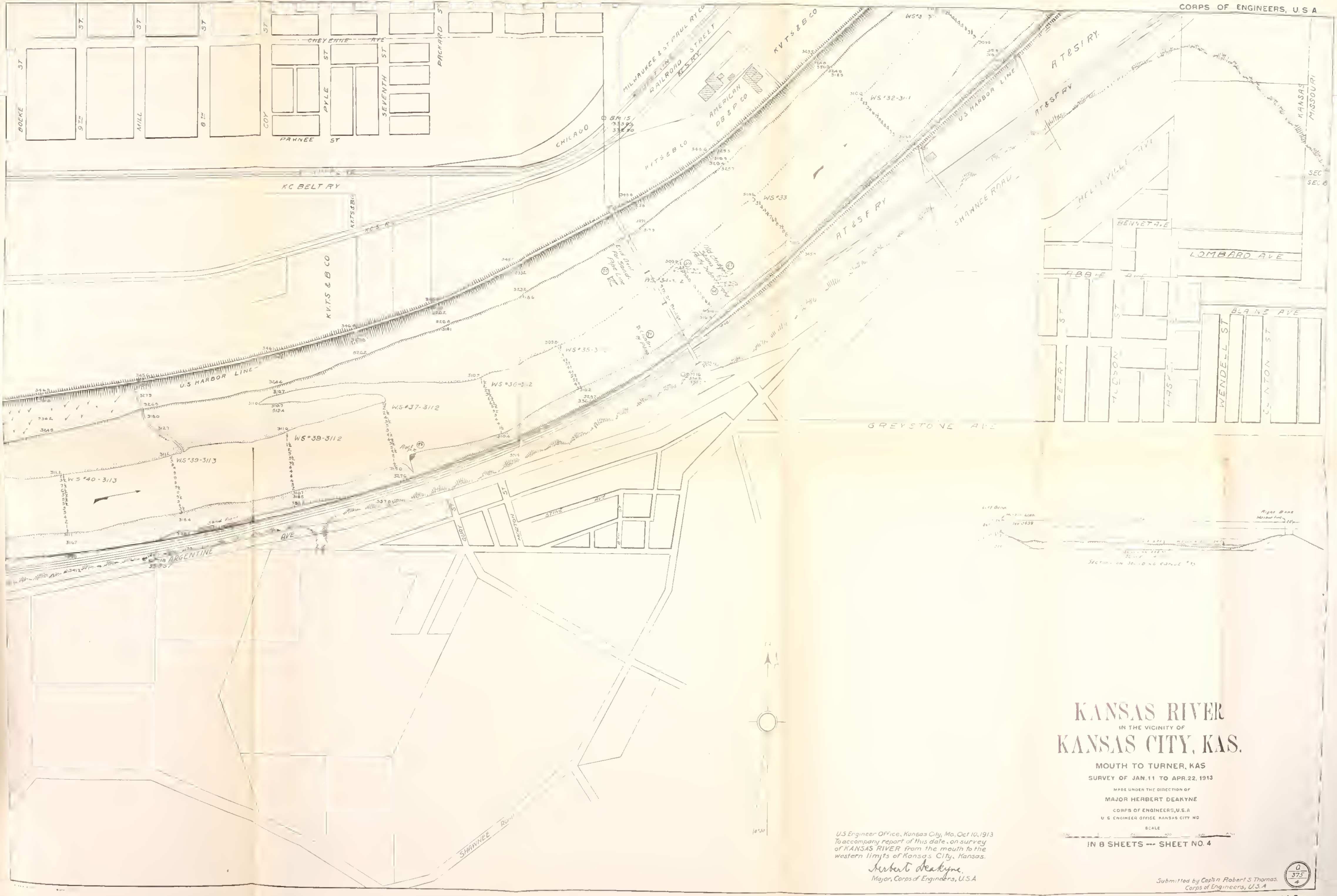
Q
375
3

Submitted by Captain Robert S Thomas,
Corps of Engineers, U.S.A

House Doc. No. 584; 63d Cong., 2d Sess.

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S.A.



KANSAS RIVER

IN THE VICINITY OF

KANSAS CITY, KAS.

MOUTH TO TURNER, KAS

SURVEY OF JAN. 11 TO APR. 22, 1913

MADE UNDER THE DIRECTION OF

MAJOR HERBERT DEAKYNE

CORPS OF ENGINEERS, U.S.A.

U.S. ENGINEER OFFICE KANSAS CITY MO

SCALE

IN 8 SHEETS --- SHEET NO. 4

U.S. Engineer Office, Kansas City, Mo., Oct 10, 1913
To accompany report of this date, on survey
of KANSAS RIVER from the mouth to the
western limits of Kansas City, Kansas.

Herbert Deakyne
Major, Corps of Engineers, U.S.A.

Submitted by Capt'n Robert S Thomas,
Corps of Engineers, U.S.A.

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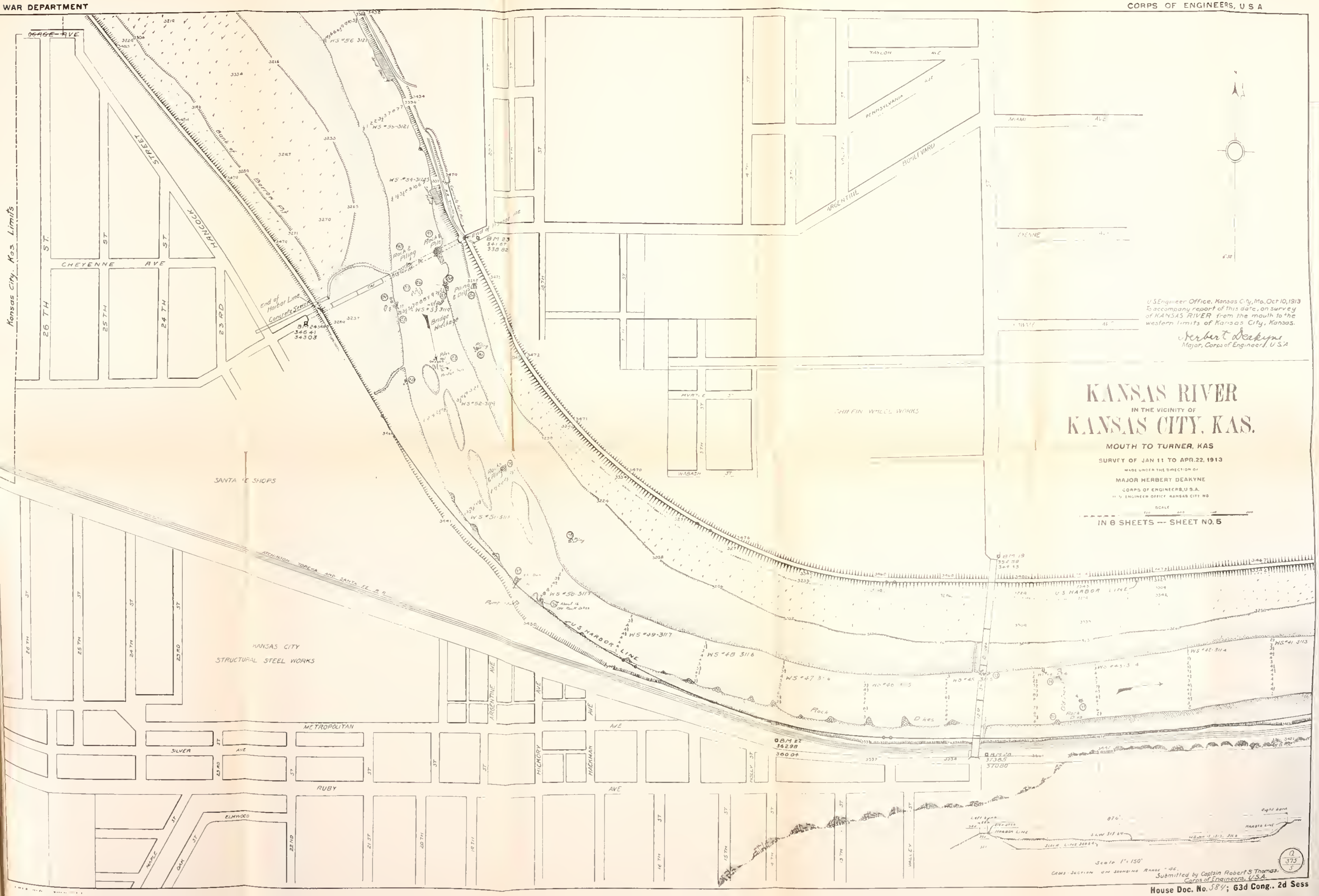
House Doc. No. 584; 63d Cong., 2d Sess.

WAR DEPARTMENT

CORPS OF ENGINEERS, U S A



U S Engineer Office, Kansas City, Mo. Oct 10, 1913
To accompany report of this date, on survey of KANSAS RIVER from the mouth to the western limits of Kansas City, Kansas.

Herbert Deakyne
Major, Corps of Engineers, U S A

KANSAS RIVER
IN THE VICINITY OF
KANSAS CITY, KAS.

MOUTH TO TURNER, KAS

SURVEY OF JAN 11 TO APR.22, 1913

MADE UNDER THE DIRECTION OF

MAJOR HERBERT DEAKYNE

CORPS OF ENGINEERS, U S.A.

U. S. ENGINEER OFFICE KANSAS CITY MO

SCALE

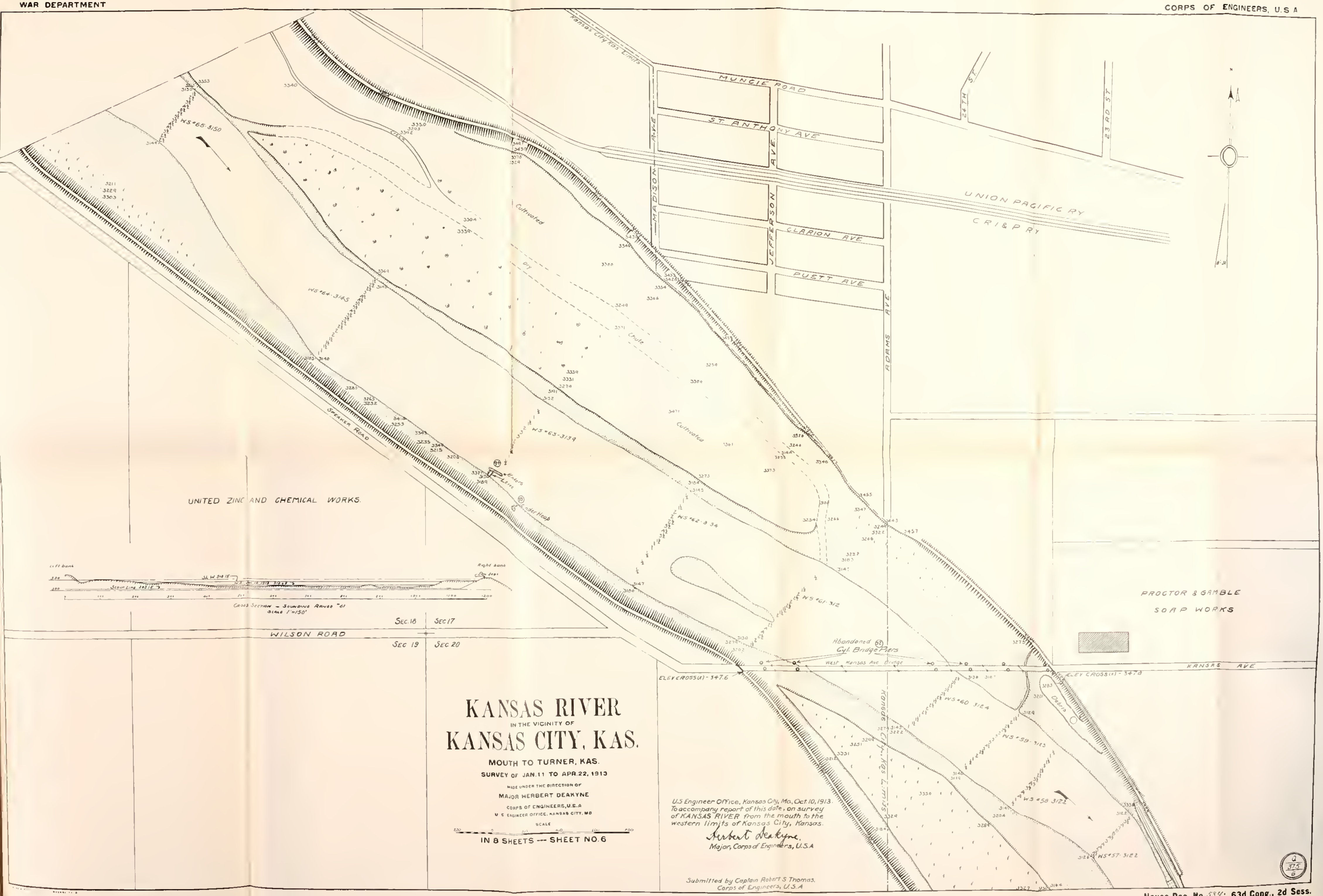
IN 8 SHEETS --- SHEET NO. 5

Scale 1" = 150'

Cross-Section on Sounding Range #46.

Submitted by Captain Robert S Thomas.
Corps of Engineers, U.S.A.

House Doc. No. 584; 63d Cong., 2d Sess



KANSAS RIVER
IN THE VICINITY OF
KANSAS CITY, KAS.

MOUTH TO TURNER, KAS.
SURVEY OF JAN. 11 TO APR. 22, 1913
MADE UNDER THE DIRECTION OF
MAJOR HERBERT DEAKYNE
CORPS OF ENGINEERS, U.S.A
U. S. ENGINEER OFFICE, KANSAS CITY, MO

SCALE

IN 8 SHEETS --- SHEET NO. 6

U.S Engineer Office, Kansas City, Mo., Oct. 10, 1913.
To accompany report of this date, on survey of KANSAS RIVER from the mouth to the western limits of Kansas City, Kansas.
Herbert Deakyne.
Major, Corps of Engineers, U.S.A

Submitted by Captain Robert S Thomas,
Corps of Engineers, U.S.A

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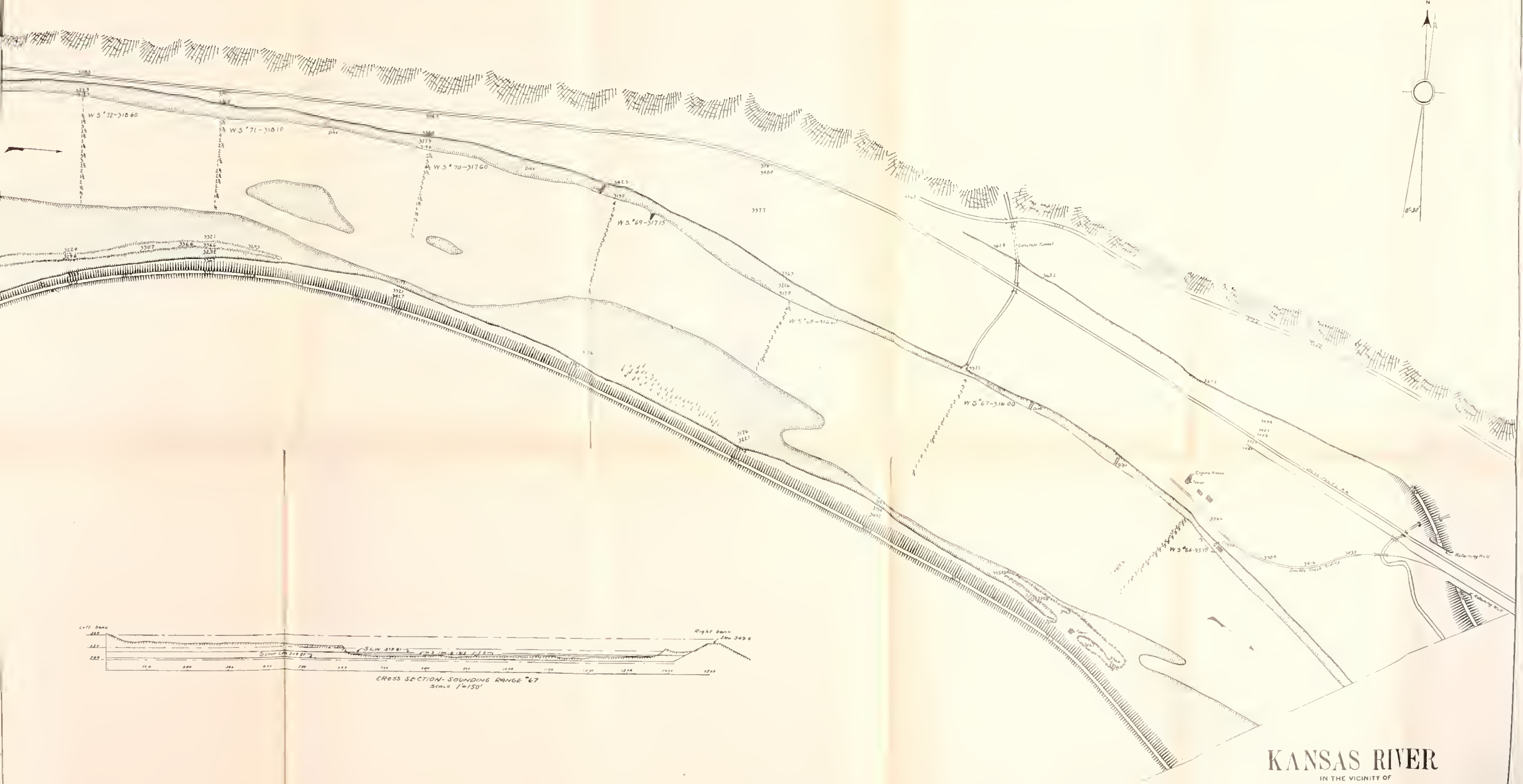
WAR DEPARTMENT

CORPS OF ENGINEERS, U.S.A.



KANSAS RIVER

IN THE VICINITY OF

KANSAS CITY, KAS.

MOUTH TO TURNER, KAS.

SURVEY OF JAN. 11 TO APR. 22, 1913

MADE UNDER THE DIRECTION OF

MAJOR HERBERT DEAKYNE

CORPS OF ENGINEERS, U.S.A.

U.S. ENGINEER OFFICE, KANSAS CITY, MO.

SCALE

IN 8 SHEETS --- SHEET NO. 7

U.S. Engineer Office, Kansas City, Mo., Oct. 10, 1913.
To accompany report of this date, on survey
of KANSAS RIVER from the mouth to the
western limits of Kansas City, Kansas.

Herbert Deakyne,
Major, Corps of Engineers, U.S.A.

Submitted by Captain Robert S. Thomas,
Corps of Engineers, U.S.A.

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House Doc. No. [illegible], 63d Cong., 2d Sess.

WAR DEPARTMENT

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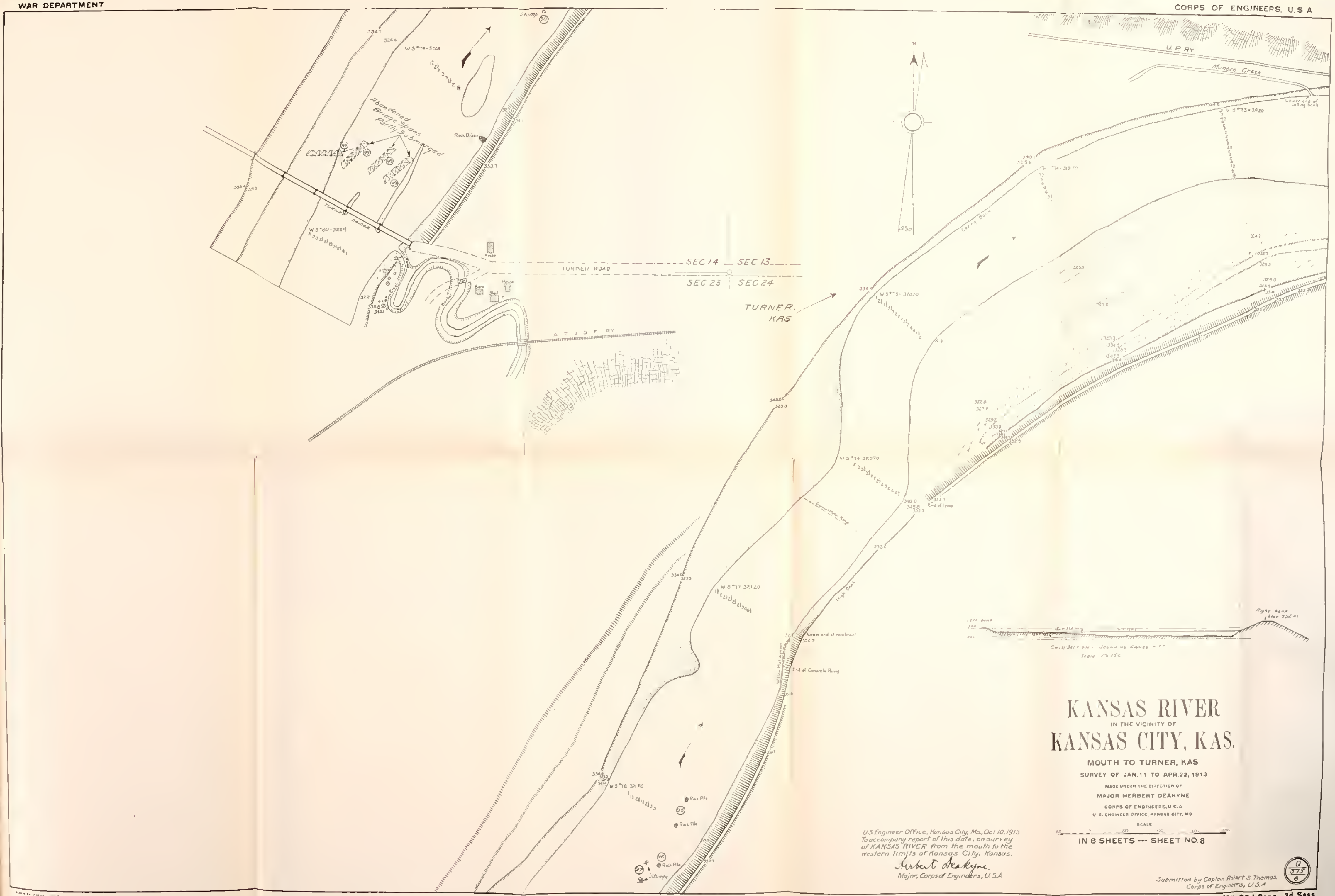

KANSAS RIVER

IN THE VICINITY OF

KANSAS CITY, KAS.

MOUTH TO TURNER, KAS

SURVEY OF JAN. 11 TO APR. 22, 1913

MADE UNDER THE DIRECTION OF
MAJOR HERBERT DEAKYNE
CORPS OF ENGINEERS, U.S.A
U.S. ENGINEER OFFICE, KANSAS CITY, MO

SCALE

IN 8 SHEETS --- SHEET NO. 8

U.S. Engineer Office, Kansas City, Mo., Oct 10, 1913
To accompany report of this date, on survey of KANSAS RIVER from the mouth to the western limits of Kansas City, Kansas.

Herbert Deakyne.
Major, Corps of Engineers, U.S.A

Submitted by Captain Robert S. Thomas.
Corps of Engineers, U.S.A

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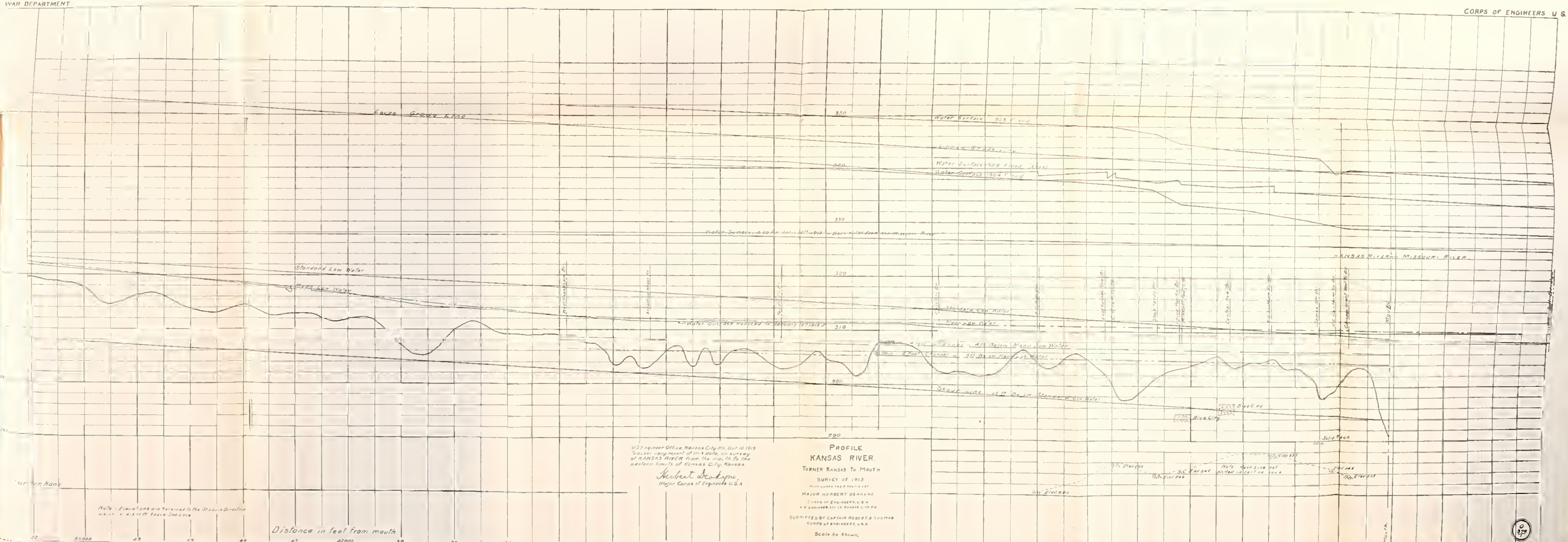
House Doc. No. 584; 63d Cong., 2d Sess.



U.S. Engineer Office, Kansas City Mo. Oct 10 1913
To accompany report of this date, on survey
of KANSAS RIVER from the mouth to the
western limits of Kansas City, Kansas

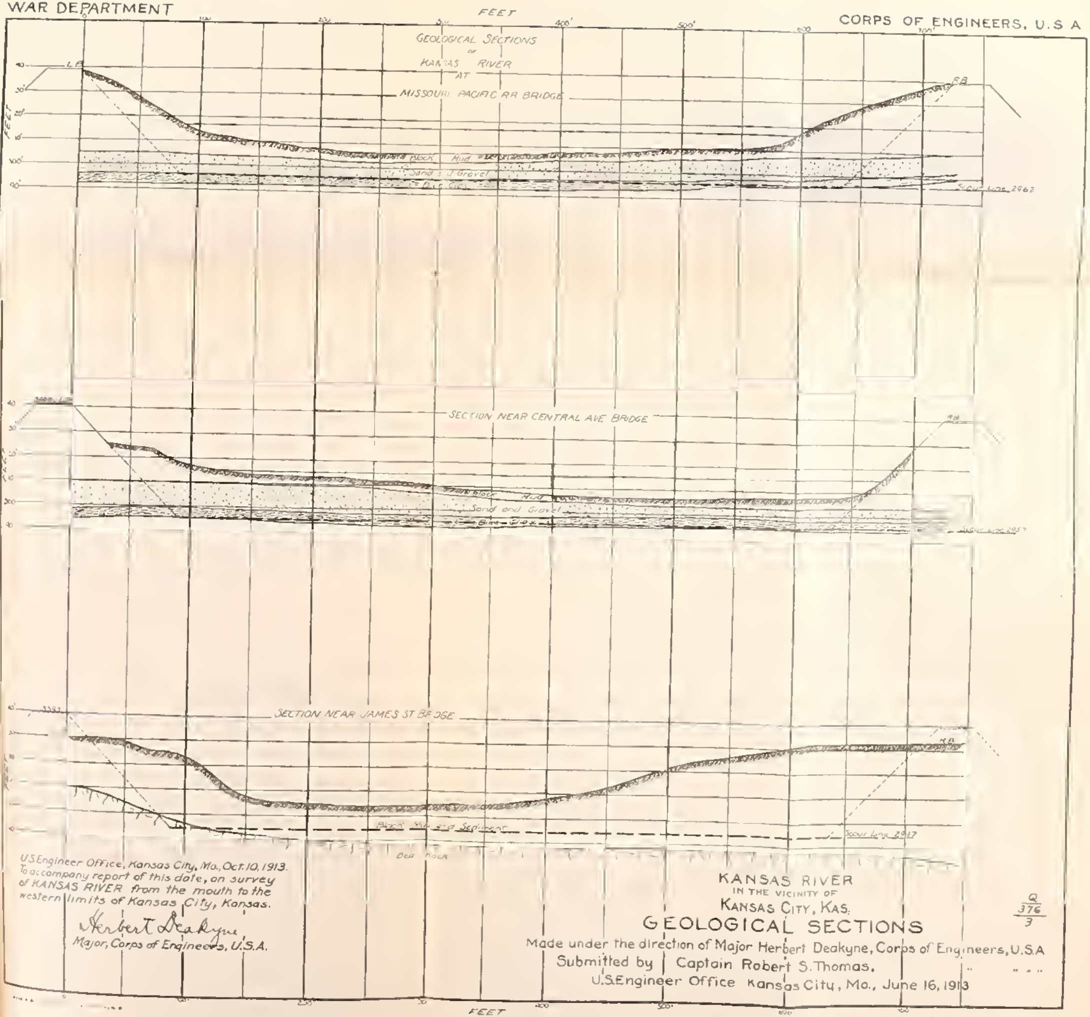
Herbert Deakyne,
Major Corps of Engineers U.S.A.

PROFILE
KANSAS RIVER.
TURNER KANSAS TO MOUTH
SURVEY OF 1913
MADE UNDER THE DIRECTION OF
MAJOR HERBERT DEAKYNE
CORPS OF ENGINEERS, U.S.A.
U.S. ENGINEER DIST. OF KANSAS CITY MO.
SUBMITTED BY CAPTAIN ROBERT S. THOMAS
CORPS OF ENGINEERS, U.S.A.
Scale As Shown.

Note — Elevations are referred to the St. Louis Directrix
which is 413.17 ft above Sea Level

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S.A.



U.S. Engineer Office, Kansas City, Mo., Oct. 10, 1913.
To accompany report of this date, on survey of KANSAS RIVER from the mouth to the western limits of Kansas City, Kansas.

Herbert Deakyne
Major, Corps of Engineers, U.S.A.

KANSAS RIVER
IN THE VICINITY OF
KANSAS CITY, KAS.
GEOLOGICAL SECTIONS

Made under the direction of Major Herbert Deakyne, Corps of Engineers, U.S.A.
Submitted by Captain Robert S. Thomas. " " "
U.S. Engineer Office Kansas City, Mo., June 16, 1913

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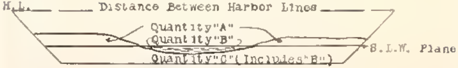
House Doc. No 584; 63d Cong., 2d Sess.

Sheet # 1.

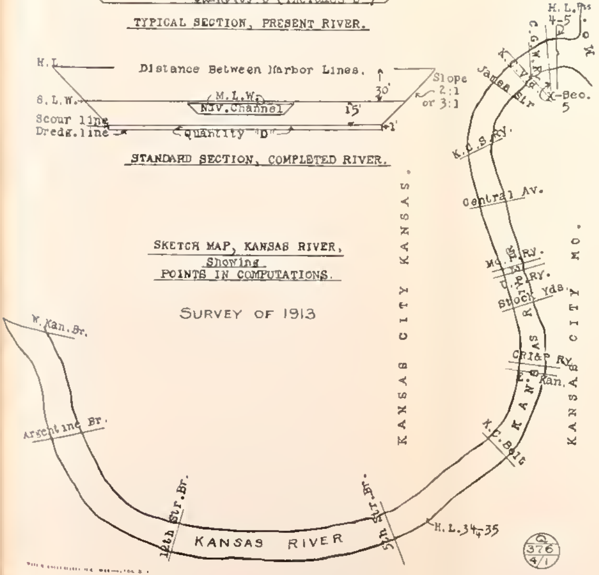
KANSAS RIVER ESTIMATES.

U.S.Engineer Office, Kansas City, Mo.
May, 1913

Sketches.



TYPICAL SECTION, PRESENT RIVER.



STANDARD SECTION, COMPLETED RIVER.

SKETCH MAP, KANSAS RIVER,
Showing
POINTS IN COMPUTATIONS.

SURVEY OF 1913

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376
4/1

Sheet # 2.

KANSAS RIVER ESTIMATES.

U.S.Engineer Office, Kansas City, Mo
May, 1913

Tabulations.

Quantity "A", To Be Added to Prism "C+D".

53 Cross Sections -------------------- 2,851,100. Cu.Yds

Quantity "B" To Be Subtracted From Prism "C+D".

53 Cross Sections -------------------- 2,488,600. " "

Prism "C+D"

Distance	Reference Points or Lines.	Volumes in Cu.Yds
1,035 Feet	Between Mouth & H L.Pts.4-5	438 980
14,967 "	" H.L.Pts.4-5 & H.L.Pts.34-35	5,163,061
2,136 "	" H.L.Pts.34-35 & H.L.Pts.41-42	836,711
8,932 "	" H.L.Pts.41-42 & Argentine Br.	3,488,983
	Total ----------------	9,927,735 Cu.Yds

Total Amount To Be Removed, Completed River.

Prism "C+D" ----------------	9,927,735	Cu.Yds
Quantity "A", Added, ----------------	2,851,100	
Total ----------------	12,778,835	Cu Yds
Quantity "B", Subtracted, ----------------	2,488,600	
Final Yardage --------	10,290,235	Cu.Yds

Navigation Channel Estimate, 6 Ft. Depth.

Distance	Reference Pts. or Lines.	Volumes Cu.Yds
1,750 Feet	Between Mouth & X-Section 5	24,808
26,524 "	" X-Section 5 & Argentine Br.	285,914
3,586 "	" Argentine Br. & W. Kansas Ave.Br.	30,417
	Total Yardage For Navigation Channel	341,139 Cu.Yds

Navigation Channel Estimate, 4 Ft. Depth.

Mouth to West Kansas Ave. Br. ---------------- 106,900 Cu.Yds

Navigation Channel Estimate, 4 & 6 Ft. Channel.

Mouth to Belt Line Br.-6 Ft.Channel, &.
Belt Line Br.to W.Kansas Ave.Br.-4 Ft. Channel- Total 229,735 Cu.Yds.

Q
376
4/2